Railway Age Gazette
MECHANICAL EDITION
INCLUDING THE
AMERICAN ENGINEER

PUBLISHED ON THE FIRST THURSDAY OF EVERY MONTH BY THE
SIMMONS-BOARDMAN PUBLISHING COMPANY,
WOOLWORTH BUILDING, NEW YORK, N. Y.

CHICAGO: Transportation Bldg. CLEVELAND: Citizen's Bldg.
LONDON: Queen Anne's Chambers, Westminster.

EDWARD A. SIMMONS, *President*. L. B. SHERMAN, *Vice-President*.
HENRY LEE, *Secretary*.
The address of the company is the address of the officers.

ROY V. WRIGHT, *Editor*.
E. A. AVERILL, *Managing Editor*. A. C. LOUDON, *Associate Editor*.
R. E. THAYER, *Associate Editor*. GEORGE L. FOWLER, *Associate Editor*.

Subscriptions, including the eight daily editions of the *Railway Age Gazette* published in June in connection with the annual conventions of the Master Car Builders' and American Railway Master Mechanics' Associations, payable in advance and postage free:

United States, Canada and Mexico	$2.00 a year
Foreign Countries (excepting daily editions)	3.00 a year
Single Copy	20 cents

Entered at the Post Office at New York, N. Y., as mail matter of the second class.

WE GUARANTEE, that of this issue 4,250 copies were printed; that of those 4,250 copies, 3,747 were mailed to regular paid subscribers and 150 were provided for counter and news companies' sales; that the total copies printed this year to date were 4,250—an average of 4,250 copies a month.

VOLUME 88. JANUARY, 1914. NUMBER 1.

CONTENTS

Articles on Car Work

When this paper reaches your hands there will still be nearly thirty days before the close of the competition on articles relating to the work of the car department. Three weeks is not too much time to prepare a good article unless you already have the subject matter pretty well arranged in your mind. We take this opportunity of calling your attention to the nearness of the closing date—February 1—and to urge that you submit your article as soon as possible. The judges are all busy men and the articles which reach us early can be submitted to them before the closing date and thus lighten their labor and allow us to announce the winner in the March number. However, do not understand this to mean that we prefer to receive a poorly prepared article early in preference to a carefully considered one which reaches us at the closing date. We want your best efforts and are willing to pay well for them. The prize of $50 of course, can be given to but one contestant, but if your article is suitable for publication, and is used, you will be well paid for your trouble. Remember that this competition includes articles which cover any phase of the interest or work of the whole car department. Articles on design, repair, operation, car shops, labor, etc., will be considered.

Four Cylinder Locomotives

The Paris, Lyons & Mediterranean has recently completed a four years comparative test between two four-cylinder locomotives, one being compound and the other simple. The test was made under exactly similar conditions. Both were of the Pacific type, the compound weighing, in average working order, about 3,500 lb. less than the simple. A summary of the results shows that 16 per cent greater loads, higher speeds and more rapid acceleration have been attained by the compound. There was also a saving of 20 per cent in coal and 13 per cent in water. As a result of these tests 85 similar compound engines have been built or are under construction. The state railways of Sweden have also found similar success with compound locomotives and are re-introducing them.

It is interesting to note the readiness with which this type of engine is accepted on the other side of the water, in view of the fact that so few are used in this country. It might be said, however, that had these four-cylinder compound engines been compared with two-cylinder simple engines of the same power there might have been some difference in the results obtained, especially if the cost of maintenance was also taken into consideration. In the comparison with a four-cylinder simple engine, the complications in construction were the same for both engines, and the tests covered only the economy while the locomotives were running. The general use of four-cylinder engines on the continent, however, shows clearly the excellent conditions existing in regard to maintenance. Another factor is that the service so far as weight of trains is concerned is not as severe as it is in this country. The speed of trains, however, is greater in many cases. For these reasons the continental railways find it possible to use many of the refinements in locomotive construction that are believed to be impractical in America.

No one can make a comparison between foreign and American locomotives that will be at all satisfactory without going into great detail as to the character of the roadway, labor conditions, cost of materials and labor, and even financial considerations and the racial characteristics of the people. Even then, individual exceptions arise which require special treatment. For instance, the Santa Fe in this country is running a large number of balanced compound Pacific type locomotives. They have had long experience with the balanced compound engine and the cranked axle and show no inclination to discontinue this type. In fact the decision is to continue its use and the latest order of heavy passenger locomotives are balanced compounds.

No one can fairly claim that the service of locomotives on the Santa Fe, at the present time, is not as good or even considerably better than the average road in this country. Thus the balanced compound is a success on one typical American railway but, nevertheless, it cannot be correctly stated that it has been a success in the country as a whole. It may be some day.

We cannot afford to overlook the lessons that can be learned from closer attention to the locomotive development on foreign railways, any more than they can afford to overlook what we are doing. It is doubtful if this fact is as fully appreciated, as it should be.

Roller Bearings on Coaches

It is frequently necessary to put a second locomotive on a high speed passenger train entirely for the purpose of providing sufficient reserve capacity to make up the time lost by slow downs and stops from block signals or other interference, cold weather or a bad rail. All railroad men know how long it takes even the largest passenger locomotive to bring a heavy train from a stop to full speed, and when these stops or slow downs occur every few miles the time lost is a serious matter.

While by no means all of the resistance of starting a heavy passenger train is that due to the journals, the journal resistance is a continually increasing proportion of the total resistance as the speed is decreased and of course, at the instance of starting, it comprises nearly 100 per cent of the resistance. Therefore, anything which will reduce the journal friction has an immediate affect on the rate of acceleration and reduces the time lost by slowdowns and stops along the road. Furthermore, the reduced journal friction will also, of course, somewhat reduce the tractive effort required to pull the train at full speed.

Roller bearings have been running on a moderately heavy passenger coach for over three years. They have been fully successful on that car and the tests made indicate the possibility of a considerable fuel saving from a train made up of cars so equipped. This car is on the Bangor & Aroostook and the construction of the bearings and the service of the car, as well as some tests, are given in an article elsewhere in this issue. While ball bearings have not yet had the opportunity of showing their possibilities in a full size steam railroad car for this length of time, the experience with them on a very heavy all-steel coach, covering a few months indicates that a successful arrangement of journal with ball bearings can also eventually be expected. Another similar all-steel coach is fitted with roller bearings in much the same form as is used on the Bangor & Aroostook, and both of these cars are now in regular every day service.

When the reliability of this character of journal and anti-friction bearing is fully proved, there is no doubt but the advantages offered will be quickly grasped, especially by those roads which are fully equipped with block signals and are subject to frequent congestions of traffic.

Improvements in Locomotives

If you should ask the question, "In what way has progress been shown in locomotive design during the past year?" you would probably receive the reply, from most railroad men, to the effect that it was the extensive application of the superheater and brick arch, larger locomotives and the perfection of the mechanical stoker. Such an answer would be correct so far as it goes, but there are many other things going on in connection with locomotives which eventually may be as important in their final effect on the efficiency and capacity of the locomotive as the superheater has been.

An article in the Railway Age Gazette (December 26) reviews the recent progress and draws attention to a number of very interesting phases of the development which are not as prominent as those mentioned above.

One of these is the success that is following the use of alloy steel properly heat-treated for locomotive parts. In addition to those parts where the steel is used for its effect in giving greater reliability or improved wearing qualities, such as frames, springs, axles and tires, it is also used for other parts where, indirectly, it permits a large increase in the capacity of passenger locomotives. This result comes about from the fact that the permissible weight that can be put on drivers depends very largely on the weight of the excess counterbalance that is included to balance the reciprocating parts. Therefore, by lightening the reciprocating parts and reducing this excess it is possible and permissible to use an increased static weight on the driving wheels. This in turn means that the boiler can be very materially enlarged and thus the capacity of the locomotive will be increased.

Alloy steels, properly heat treated when combined with careful designing, will accomplish much in reducing the weight of the reciprocating parts. The Pennsylvania has shown in its latest Atlantic type locomotive what can be done in this direction. The total weight of all the reciprocating parts on one side of this locomotive, which has cylinders 23½ in. x 26 in., is but 1,000 lbs. There are probably very few Atlantic type locomotives, of even less power than this one, where the reciprocating parts on one side will be much less than 1,500 lb. The net result of the reduction is that a dead weight greater than 65,000 lb. can be placed on each axle of this locomotive with entire safety. At 70 miles an hour the dynamic augment of the excess counterbalance is less than 30 per cent of the dead weight on the drivers and the locomotive will not impose as great a strain on the track nor do as much damage to itself as most engines which have a weight of from 50,000 to 55,000 lb. on each driving axle.

This is one of the things that alloy steel has done, but it is not to be understood that the success of this locomotive is entirely the result of the use of this material. Among other features a new method of equalizing the weight has been employed which has been very influential toward the final success of the design. It seems that there is yet considerable to be learned about the equalizing of locomotives.

Proper opening for the admission of air to the ash pan has a surprising effect on the economy and capacity of the locomotive. Some people are beginning to realize their shortcomings in this direction, and many of the recent locomotives are showing the effect. You cannot get too large an air inlet to the ash pan and the opening through the grates should be as large as the quality of fuel used will permit. The design of the grates themselves has also shown considerable improvement.

Progress is also being made in the appreciation of the value of a long flameway between the bed of fuel and the admission to the tubes. This of course followed a more careful investigation as to the reason why the brick arch gave the economy it is showing. It developed that it is simply a matter of allowing sufficient time for the completion of the reaction which starts at the beginning of the distillation of the gases from the fuel but is checked immediately the gases enter the end of the tubes. It is this principle which largely accounts for the improvement that followed the introduction of the combustion chamber. Advantage is being taken of this knowledge by the more progressive roads and larger fireboxes are becoming the rule. There is no doubt but that there can be further progress made along this line, and it is probable that increased knowledge of the processes of combustion and the best construction to obtain the full value from the fuel will be the line of greatest advance during the next year.

There is another movement that has gradually taken place which has not received much comment, and that is the use on some of the more recent and best designed locomotives of comparatively large cylinders. This practice has been found advisable for use in connection with superheated steam where

it was clearly shown, by the work on the locomotive testing plant at Altoona, that for the best results in economy, the cut-off should not be later than 30 per cent. On some of the larger freight locomotives increased size of cylinders is also being used in connection with the stoker since it has been found that the steam making capacity of the boiler is decidedly increased and the larger cylinders can be used to good effect.

An increase in the effort to standardize locomotive parts and even in some cases the standardization of the whole locomotive, which is gradually becoming more general, is by no means the least important tendency of the times. Some roads have had a greater opportunity to accomplish results along these lines than have others and are now noticing the pleasing effect on their maintenance costs.

As the Railway Age Gazette article points out, valve gears are by no means being overlooked in the general improvement and considerable change toward the use of lighter parts and improved steam distribution can be expected.

It has been suggested by H. Montgomery, superintendent of motive power and rolling stock of the Rutland, that roller or ball bearings could be used to good advantage in the connections in the valve gear. The proper sizes of such bearings can be purchased and their advantage in this connection would no doubt be worth having. So far, however, no one has made such an application.

The value of the railway supply companies to the railroads and an appreciation of their work is given in this article in the following words: "Credit should be given to various railway supply companies, locomotive builders and other auxiliary activities for developing original improvements and the energy put forth in co-operation with the railway companies in bringing locomotives to the highest state of efficiency. Many of the most important and valuable appliances which are now in universal use would, beyond doubt, have languished for many years had it not been for the interest and energy of supply companies in rapidly developing them to a state of perfection. The superheater, brick arch and stoker are prominent examples. Under the present organization of the motive power departments on many railroads, there is little opportunity for initiative or experiments, and the work of the locomotive builders and supply companies has been of very great importance and value in the bringing of the American locomotive to its present position."

Locomotive Boiler Inspection

The attendance and interest shown in the paper presented by Frank McManamy, chief inspector of locomotive boilers, Interstate Commerce Commission, at the December meeting of the Western Railway Club, is a good indication of the efforts being made by the railways of this country to better understand the requirements of the federal boiler inspectors, and to do their best to live up to these requirements. It was suggested by one speaker that the federal boiler inspection department definitely decide on certain devices that would be acceptable to it, and to definitely state where they should be located and the manner in which they should be connected to the locomotive. But, as Mr. McManamy said, the purpose of the law is not to standardize locomotive equipment and thus hinder development, but to see that, no matter what device is applied to a locomotive, it is perfectly safe and will not in any way affect the safe operation of the locomotive. This attitude of the locomotive boiler inspection department is most admirable, broad and constructive.

From the discussion it is evident that the railroads and the federal inspectors are getting closer together than when the boiler inspection law was first put into effect. As Mr. McManamy intimated, the purpose of the commission is not to keep hitting the railroads over the head with a club, but to act more or less as a check on the boiler work. When changes may be made for the increased safety of locomotive boilers it is the idea of the inspectors to reason out with the railroad mechanical officers wherein these items may be changed to insure safety to locomotive operation.

The results obtained during the fiscal year ending June 30, 1913, show in certain respects a marked improvement over the previous year; less trouble was experienced and there seems to be a closer relation between the boiler inspectors and the railroads. There were 21.7 per cent. more locomotives inspected, 11.8 per cent. more were found defective, and 38.4 per cent. more were held out of service than last year.

Mr. McManamy directed attention to the possibility of failure in welds of superheater tubes. Thus far only one failure of this sort which has caused injury has been reported, and investigation has shown that this was due to the flue being thinned by heating in a defective furnace. There are now over 10,000 superheater locomotives in this country, with a total of about 300,000 large flues. A very large percentage of these have been safe-ended one or more times, so that the percentage of failure thus far is extremely small, almost negligible, in fact. The superheater has come into prominence very rapidly, and in the early stages of its introduction many of the railroad shops were not equipped with the heavy machinery for safe-ending the superheater flues. Very many of the welded flues now in service were welded under power hammers with improvised dies, or in flue welding machines which were designed and constructed to handle very much smaller tubes. Now, however, the railroads are rapidly installing improved and heavier machinery designed particularly for handling the large flues, and within the next few years all of the roads will probably be well equipped to handle the large flues with the best of equipment. Undoubtedly, therefore, since the methods of handling these flues have been improving rapidly, there should be no great trouble from this source if the welding is given proper attention. The department of locomotive boiler inspection has not laid down any regulations as to the handling of these flues, and will not unless the trouble should increase to such an extent as to make it necessary for the department to interfere.

NEW BOOKS

Alternating Currents and Alternating Current Machinery. By D. C. and J. P. Jackson. Bound in cloth, illustrated, 967 pages, 5½ in. x 8¼ in. Published by the Macmillan Company, 66 Fifth avenue, New York. Price $5.50.

Since 1896, when the book was first published, the Jacksons on alternating current has been recognized as one of the leading authorities and text books on this involved subject. Owing to the rapid progress that has been made during the past ten years in the solution of difficult problems connected with alternating current machinery and the development of new phases of many of the older problems, it has been necessary to rewrite and greatly extend the original book. The new edition maintains the well-known features of the earlier work in which were worked out the characteristics of electric currents, their self-induction, electrostatic capacity, reactance and impedance, and the solutions ot alternating current flow in electric circuits in series and parallel but more attention has been given to the transient state in electric circuits than was the case in the original edition. A large amount of related matter has been introduced and the treatment of power and power factor has been given greater attention. More space and more complete treatment has also been assigned to synchronous machines and synchronous motors and generators. While this book is intended primarily as a text book for colleges and advanced schools it is also of great value as a reference work for all engineers who have to deal with alternating current.

COMMUNICATIONS

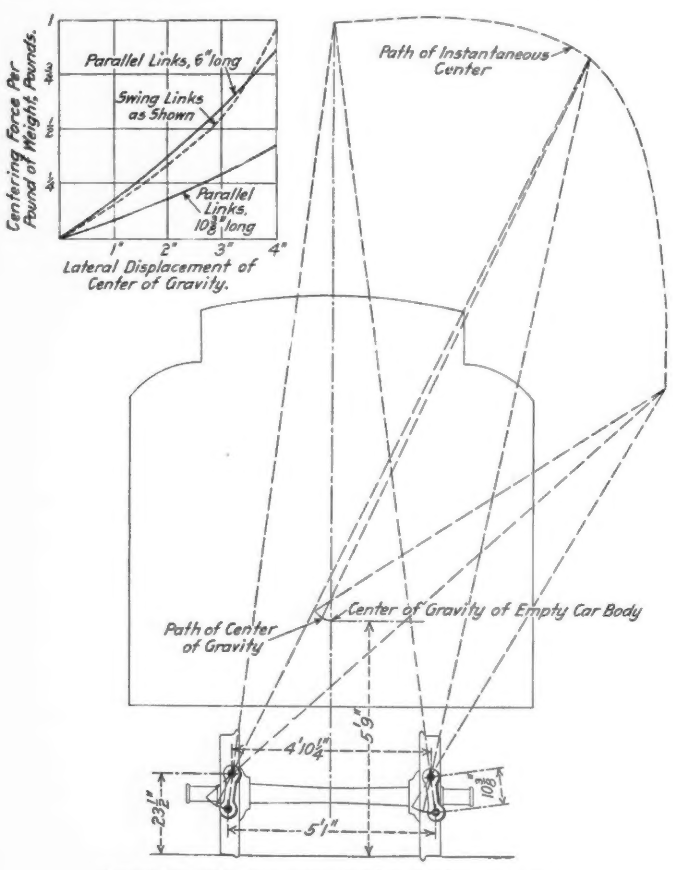
WHY DO WE INCLINE SWING LINKS?

BOSTON, Mass., November 5, 1913.

TO THE EDITOR:

As is well known, it is the custom to incline swing links downward and outward when in their normal position. The result is this: When a car approaches a curve, the outside wheels of the leading truck are raised by the elevation of the outer rail, and the swing of the links increases the torsion in the car body, overloading the springs on diagonally opposite corners. This undesirable effect raises the question of the advantages of inclining the links.

An investigation brings out statements variously worded, but in general they seem to signify that swing links are employed to cushion the shocks between the rails and the car body by allowing the center of gravity of the body to have a lateral



Graphical Study of the Action of Swing Links

motion, and the links are inclined to prevent, or reduce, that same lateral motion and keep the center of gravity over, or nearly over, the center of the track. If the links are so arranged that their center lines cross at the height of the center of gravity of the body, it is clear that the arrangement is just as rigid as any rigid truck could be. The ordinary incline, however, only partially neutralizes the effect of the swing. The criterion of the effectiveness of the links is the relation between the lateral displacement of the center of gravity of the body and the centering force produced by the weight. This can be controlled within practical limits by the length of the links or by the use of symmetrical three-point suspension hangers.

The accompanying diagrams were made as a study of a special case. The large one shows the path of the center of gravity of the car body as the links swing, and the smaller one shows the relation between the lateral displacement and the centering force with the car as shown, having the links of the same length but parallel, and with parallel links six inches long. It shows that the centering tendency would be practically the same with the six-inch links, and the advantages of the inclination disappear.

In this connection it is interesting to observe that occasionally the links are inclined downward and inward, and the practice is upheld by the explanation that it allows the center of gravity to swing out more freely, throwing more weight on the outer wheels and facilitating the inevitable slipping of one of the wheels on curves.

G. E.

STANDARD GAGE TRACKS THROUGH SHOP BUILDINGS

WINNIPEG, Man., December 12, 1913.

TO THE EDITOR:

In the article on page 648 of the December number on "Standard Gage Tracks Through Shop Buildings," Mr. Duffey says "It is a great mistake to make no provision for a standard gage track from end to end of the center section of the shop."

This does not appear right to me, as instead of the layout of a shop being made with a view to obtaining maximum production, as is universally recognized, we must change our viewpoint and lay out the shop with a view to facilities for erecting machinery. It is a great convenience to be able to unload and erect machinery with a crane, but while this may often be possible in machine and boiler shops it is seldom so in blacksmith shops on account of the many steam and smoke pipes to be accommodated. Apart from providing a track for unloading inside the shop, to place this track from end to end in the center of the shop is to place it right where the steam hammers are usually placed. Large steam hammers are seldom placed other than along the center of the building for several good reasons, one being that it allows a greater number of blacksmiths quick access to the hammer, and another that the shocks of a large hammer are much more equally distributed over the building. In reality the difference in cost of installing a large steam hammer with and without a power crane on a shop track is not worth considering. A few weeks ago we had occasion to renew part of the foundation under a 3,300-lb. steam hammer. We had no crane, so we set up a pair of shear legs, dismantled the machine and lifted it back from the foundation and then lifted the anvil block weighing 11 tons, all in two days, one day being spent in obtaining and setting up the shear legs and one day in the moving. Taking into consideration that a central track for a shop 200 ft. long would cost between $200 and $300 to install, and the impracticability in the case of the average shop, I am certain the balance would be on the loss instead of the profit side. With a capable millwright there is very little time lost in rigging up to lift these heavy weights, and little commotion is caused.

E. T. SPIDY,
Assistant General Foreman, Canadian Pacific.

NEW STATIONS IN GERMANY.—Within the last two years seven important new stations, representing an outlay of over $30,000,000, have been opened on the Baden Railways system.

EXCESSIVE SPEED AND ACCIDENTS.—High speed was an important contributing cause of several serious accidents during the past year. On many roads there is no limit to the speed at which passenger trains are allowed to run. Enginemen are thus encouraged to run their trains at excessive speed in an effort to make up time lost on schedules that are in many cases already sufficiently fast for safety. Such high speed is especially dangerous in times of fog or storm, when signals can be seen but a comparatively short distance. The maximum allowable speed of trains on all roads should be established at a safe limit, and it should be left entirely to the judgment of enginemen to determine whether or not this limit is exceeded. There are devices readily available which will indicate to an engineman the speed at which his train is running.—*Interstate Commerce Commission's Annual Report.*

Starting Power of a Locomotive

Discussion and Explanation of a Graphical Investigation of Various Influencing Factors

BY GEO. S. CHILES

One of the peculiarities of locomotive practice, especially noticeable by those actually operating engines, is the apparent variation in the starting power of locomotives of the same design and built from the same drawings. This variation may be encountered in an order of locomotives of the same delivery; in a duplicate order of locomotives of the same identical class, also in locomotives of the same class leaving the shops after general repairs. By some this is attributed to imagination, while others assert that it is due to factors other than those inherent in the locomotive itself. As a matter of fact, the maximum tractive effort that any locomotive can exert may depend on any one or more of several variables existing in an individual locomotive. It is the purpose of this discussion to consider three of these influencing variables, which are not ordinarily mentioned in articles dealing with the design and operation of locomotives, and determine to what extent they affect the maximum tractive effort available.

These variables are as follows: The vertical offset of the cylinder center with respect to the driving wheel center; the maximum cut-off obtainable in the cylinder, and the position of the locomotive at starting.

Inasmuch as the maximum tractive effort occurs with a maximum mean effective pressure in the cylinders, and, since the latter is the result of long cut-offs which are used only at starting or at very low speeds, while the maximum demands on the boiler occur at high or sustained average speeds, the question of boiler capacity is eliminated in this connection. Furthermore, as the tractive effort depends on the adhesive weight of the locomotive, it will be assumed that the ratio of adhesion is such that the maximum tractive effort available may be utilized. In other words, that the locomotive is not over-cylindered. In considering the subject, the graphical method of solution has been selected in preference to the analytical, in order to avoid the use of complicated mathematical equations. The graphical method is easier to comprehend, and gives results sufficiently accurate for the purpose.

THE VERTICAL OFFSET OF THE CYLINDER CENTER WITH RESPECT TO THE DRIVING AXLE CENTER.

In almost every instance the design of an American locomotive is such that the center line of the cylinders, instead of passing through the center of the main axle, is from one to four inches above it. This distance is not a constant figure, and is variably affected by the following:

First: The improper camber, or set, of the driving springs.

Second: The settling of the driving springs in service. Springs will show a decrease in camber of from ½ in. to 1½ in.

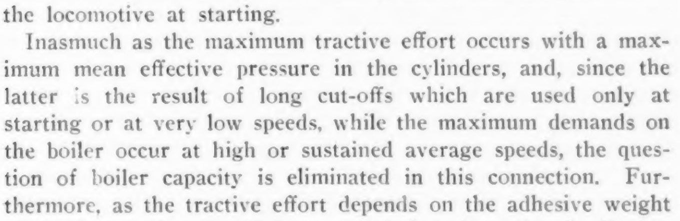


Fig. 1—Graphical Demonstration of Effect of Raising the Cylinder

after the locomotive has completed one or two round trips. This is due to the friction between the plates composing the spring. In addition, the camber of the spring may be still further decreased due to the fact that each individual plate may or may not take a gradual permanent set. This may amount, in some instances, to from ¼ in. to 1 in. in the course of a year.

Third: Variations in equalizers and spring hangers due to wear or improper workmanship.

Fourth: The wear of driving box brasses.

Fifth: The reduction in diameter of driving axles due to wear or turning down.

Sixth: The rolling of the locomotive. As this occurs principally at high speeds, it has little bearing on the present discussion.

Considering first the vertical offset of the cylinder center, refer to Fig. 1, which is drawn to an exaggerated scale for clearness. OM is the radius of the crank-pin; MM' (equal to NN') is the length of the connecting-rod, and $M'N'$ the stroke of the piston. Assuming the center line of the piston rod to be at RS. From O as a center with ON', the length of the connecting-rod, plus the radius of the crank as a radius, describe the arc $N'S$ to intersect the line RS at the point S, also from O as a center with OM' as a radius describe the arc $M'R$ to intersect RS at R. Now draw $N'S$, and parallel to it draw $M'T$. It is evident that TS, the new length of stroke, is greater than the original length $M'N'$ by the amount RT. It may be of interest to note that the dead centers, originally at M and N, are now located at A and C, and are not on a straight line through the center of the axle. Also that the travel of the reciprocating parts is shifted slightly back toward the main axle and that the angle MOA is greater than the angle NOC. Assuming a 16-in. crank, 128-in. main rod, and 4-in. rise of cylinder center, these angles are found to be 2 degrees 3 minutes and 1 degree 36 minutes respectively.

Throughout the following analysis the forward dead center will be considered as remaining at N instead of at C. The reason for this will be explained in a subsequent paragraph dealing with the variation in guide bar pressure due to the elevation of the cylinder center.

THE MAXIMUM CUT-OFF OBTAINABLE IN THE CYLINDER.

A specific example of steam distribution which may be taken as fairly representing American practice is the valve event diagram, Fig. 2. The data for this diagram was taken from a heavy Pacific type passenger locomotive, the values given being the average of the four readings (head and crank end of each cylinder). This diagram shows the different events and their relation to each other for different positions of the reverse lever. The average maximum cut-off was 83.3 per cent. of the stroke.

The indicator diagrams illustrated were taken from various types of locomotives at slow speeds. These locomotives were on test, and it is reasonable to assume that the steam distribution was superior to what it would be in the average locomotive cylinder.

Figs. 3 and 4 are reproduced from a paper on "The Piston Valve as Applied to Locomotives," by J. M. FitzGerald, read before the January 12, 1904, meeting of the New England Railroad Club. Fig. 4 shows the action of the steam in a hollow internal admission piston valve.

The diagrams shown in Fig. 5 were taken from a locomotive in freight service, and serve to illustrate the variations in cut-off which may be encountered in the same locomotive. In this instance, the throttle was open wide and the reverse lever was practically in full gear forward. The upper diagrams were taken at a speed of 2½ miles per hour (15 revolutions per minute), and the lower at a speed of 4 miles per hour (24 revolutions per minute). These diagrams are instructive in that they indicate

clearly the difference in cut-off on the right and left side of the engine.

As a further example of the actual maximum cut-off obtained in slow speed service the diagrams in Fig. 6 are taken from a

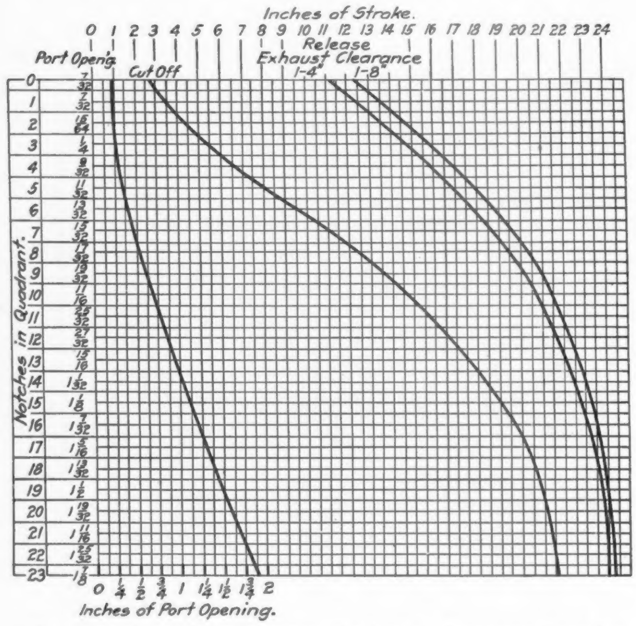


Fig. 2—Valve Event Diagram Typical of American Practice

Mallet compound locomotive operating under conditions similar to the above. In this instance the throttle was full open and the reverse lever in full gear forward; the speed being 5 miles per hour (30 revolutions per minute).

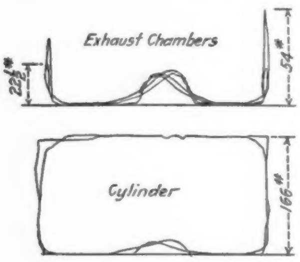


Fig. 3—Card with Solid Internal Admission Piston Valve

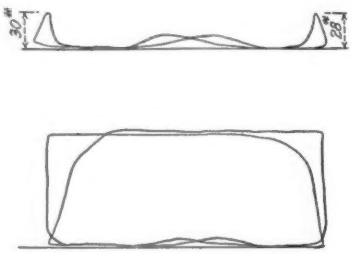


Fig. 4—Card with Hollow Internal Admission Piston Valve

The indicator diagrams *A*, *B* and *C* in Fig. 7 are each taken from a different consolidation locomotive, the speeds varying from 2.2 miles per hour (17.6 revolutions per minute) for dia-

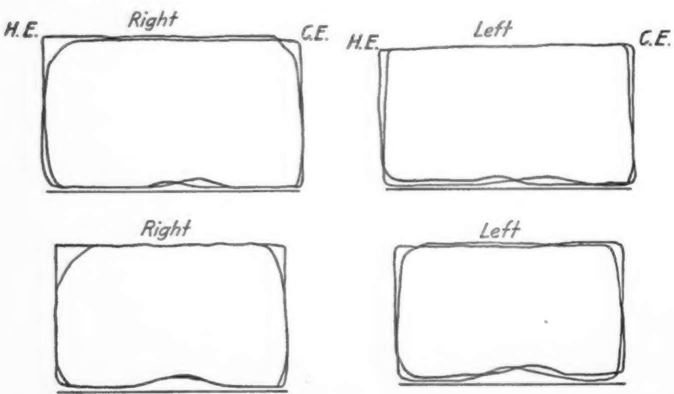


Fig. 5—Cards Showing Variation of Cut-off on Same Locomotive

gram *C* to 4 miles per hour (32 revolutions per minute) for diagram *B*. With the exception of *B*, the diagrams were taken with full throttle and reverse lever in full-gear forward. Diagram *B* was taken with the reverse lever in notch 15, although it was possible to work it as far forward as notch 20.

These cards show a wide variation in the maximum cut-off; in some instances quite a difference existing between the cut-off in the head end and crank end of the same cylinder. The average cut-off for the three diagrams taken from the consolidation locomotives, Fig. 7, varies from 72.6 per cent. to 90.4 per cent. of the stroke.

Since it is the purpose of this article to determine the effect of various cut-offs on the starting power of the locomotive, two complete indicator diagrams having cut-offs of 70 per cent. and 92

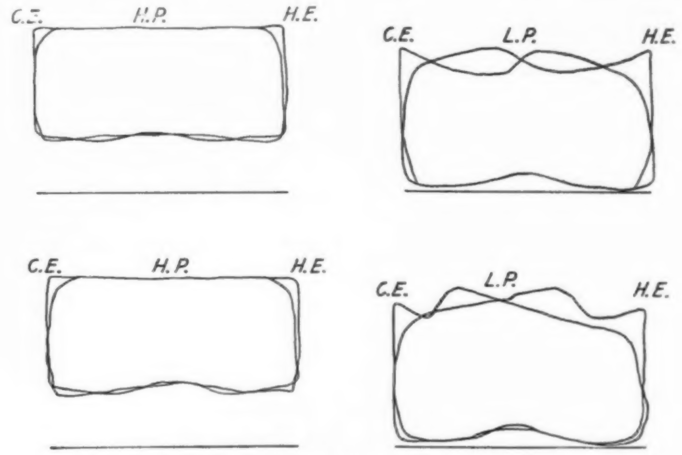


Fig. 6—Starting Cards of a Mallet

per cent. respectively have been constructed (Fig. 8). These values approximate the limiting values of the diagrams reproduced in Fig. 7, which we may assume fairly cover the range of cut-offs ordinarily obtained in starting or in slow speed service.

Accordingly, the head and crank ends of the two diagrams, Fig. 8, were constructed (the card having a 70 per cent. cut-off being superimposed upon the card having a 92 per cent. cut-off) with an equal maximum steam pressure of 184 lbs., which amounts to 92 per cent. of an assumed boiler pressure of 200 lbs. In using 184 lbs., an allowance was made for machine friction. In order to emphasize the variation in the turning force due to

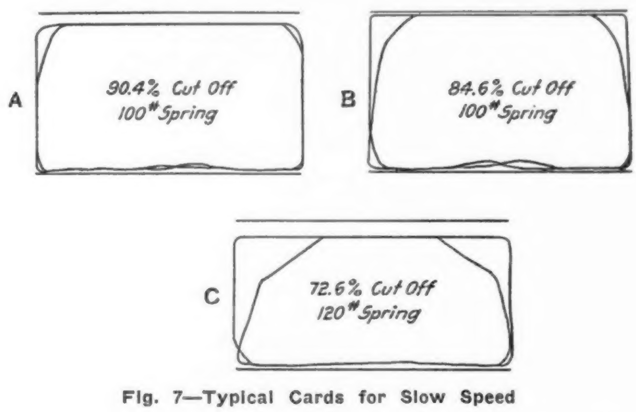


Fig. 7—Typical Cards for Slow Speed

the obliquity of the connecting-rod, the humps in the exhaust lines were removed and, in determining the force exerted on the piston by the steam in the cylinder, no deduction was made for the area of the piston rod.

Since, for a given cut-off, the diagrams are similar for each end of the cylinder, the area of the piston rod being neglected, any differences in the future analysis which might result from a variation in the force exerted by the working medium in the cylinder are eliminated, and those remaining are due solely to the mechanical principles inherent in the locomotive itself. Since the area of the piston rod has been neglected, in order to obtain

a value for the crank end of the cylinder, with which to compare with a similar value for the head end, assuming the same steam pressure in each instance, a reduction of 3 per cent. in the values of the curves for the crank end in the diagrams which are to follow is necessary.

In the lower part of Fig. 8 the full horizontal line *A-A* represents the center line of the cylinder when it intersects the center line of the driving-axle, the dotted line *C-C* representing the cylinder center raised 4 in. Starting at the right end, the position of the piston has been layed off for each 15 degrees of crank angle. It will at once be seen that the positions of the piston for the forward and back stroke will intersect on the line *A-A*, as for example when the crank is on the top and bottom quarters denoted respectively by 90 deg. and 270 deg. This, however, is not the case for the line *C-C*, the piston positions for the two strokes varying considerably as indicated by the horizontal difference between the arcs at their points of intersection with this line. The position of the piston for the different crank angles is also shown on the indicator diagrams, the full lines toward the center corresponding to the points of intersection of the arcs with the cylinder center line *A-A* and the dotted lines which are shown at the top of the diagrams corresponding to the points of intersection of the arcs with the upper cylinder center line *C-C*.

The lower diagram also shows the positions of the piston for 70 per cent. cut-off and for each successive increase in cut-off of 5 per cent. It will be noted that the cut-off lines are in two

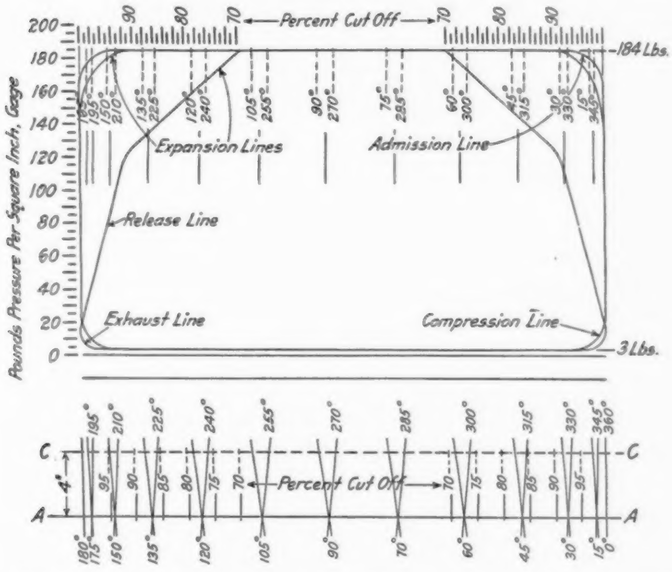


Fig. 8—Indicator Cards for 70 Per Cent. and 92 Per Cent. Cut-off

parts, one full and one dotted and that these two sections are not in line. The reason for this is because of the shift of the stroke toward the crank, due to the elevation of the cylinder center line as explained in Fig. 1, the resulting slight increase in length of the stroke being divided up equally between each end.

Figure 9 outlines the graphical method used to determine the cross-head guide pressure and the tangential force acting at the crank-pin. The former will be understood to be the pressure exerted by the cross-head on the guide due to the angularity of the main rod, and the latter is the useful component of the force transmitted through the main-rod which acts to rotate the wheels. It may be well to state that in the following graphical solution, friction was disregarded, it having been allowed for in the construction of the ideal indicator diagrams. Also that the effective steam effort is the difference between the total forces acting on the two sides of the piston. In this instance the area of the piston-rod is neglected and the effective steam effort is obtained by taking the difference between the intercepts on the pressure line on one diagram and the exhaust line of the other diagram, as given in Fig. 8.

With the crank-pin at position *A*, Fig. 9, and direction of rotation clockwise, let P_1 equal the effective steam effort transmitted through the piston-rod to the cross-head. C_1 equals the thrust on the connecting-rod, and G_1 equals the reaction of the guide which, if guide friction is neglected, will always act at right angles to the line of stroke. The mean steam effort P_1 is the product of the area of the piston by the effective steam pressure, as noted above, taken from the ideal indicator diagrams at a point corresponding to the point *F* of the cross-head travel. Assuming a convenient scale of force, draw P_1 parallel to the line of stroke *M'N'*, and from one end draw C_1 parallel to the center line of the connecting-rod *FA* to intersect the perpendicular G_1 dropped from the opposite extremity of P_1, the whole

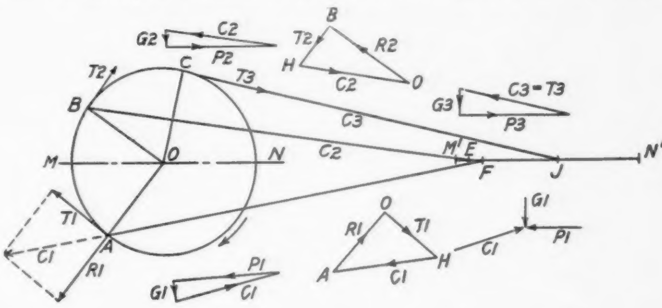


Fig. 9—Graphical Representation of the Tangential Force at the Crank Pin

forming a closed triangle of forces. Then measured to the same scale of force, C_1 equals the thrust in the connecting-rod and G_1 the reaction at the guides.

At the crank-pin, the thrust in the connecting rod C_1 is resolved into two forces: R_1 radial to the crank, and T_1 tangential to the path of the crank-pin. Using the same scale of forces and a similar triangle of forces with C_1 as the base line, the values R_1 and T_1 are found by the method just described. In a similar manner the construction is also given for the crank positions *B* and *C*, the forces P_2 and P_3 acting in the opposite direction due to the fact that the connecting-rod is now under tension, whereas it was under compression. At *C* the center line of the connecting-rod makes an angle of 90 deg. with the radial to the crank center *OC*, and the tangential force acting at the crank-pin is equal to the pull in the main-rod, thus giving the tangential force direct without the aid of the second force diagram. It is well understood that, neglecting the weight of the reciprocating parts, the pressure on the guide bars is due solely to the angularity of the main-rod which for forward rotation would act on the upper guide bar, resulting in a downward reaction, and for backward rotation would act on the bottom guide bar and result in an upward reaction. In this case, as we are considering forward rotation, only the reaction would be due to the upper guide bar and would act downward for all positions of the crank-pin.

Curves will now be constructed, showing how these forces vary during one complete revolution of the locomotive driving wheels. Considering first the forces acting on the guide bars, refer to the right of the locomotive and assume the zero position of the crank-pin to be to the forward dead center and the center line of the cylinder to intersect the main driving axle as shown at *AA*, Fig. 8. As the piston will then be at the extreme forward end of its travel, and the piston-rod and connecting-rod in line, it is evident that there could be neither any tendency to rotate the driving wheels nor any vertical pressure on the guides (neglecting the weight of the parts), even with a great excess of pressure on one side of the piston. Furthermore, at starting and at very slow speeds, the energy which has to do with the acceleration and retardation of the reciprocating parts and any change in energy due to variations in speed of rotating parts

will not be appreciable and for the purpose of this discussion may be omitted. Referring to Fig. 10, curve *A-A* gives the values for the cross-head guide bar pressure throughout one forward revolution of the drivers for the case in which the center line of the cylinder intersects the center of the main driving-axle; curve *CC* for the case in which the center line of stroke is above the axle center. The points in each case are plotted for every 15 deg. of crank-pin rotation as previously used in the description of Fig. 8. The engine is assumed to be running ahead, and the crank-pin, which is at the forward dead center, is at the zero degree of revolution. Considering the curve *A-A*, as the crank-pin moves downward the pressure on the upper guide bar gradually increases and reaches a maximum value when the center line of the connecting-rod and the radial line through the crank-pin form an angle of 90 deg. which occurs, in this instance, slightly before the crank-pin reaches the bottom quarter. This assumes that the steam pressure remains constant near the center of the stroke which should be true with long cut-offs. After reaching a maximum, the pressure gradually decreases and again becomes zero at 180 deg. This cycle is repeated in the forward stroke.

It will at once be seen that the two portions of curve *A-A* are very similar, having practically the same maximum value of about 9,600 lbs. However, with the curve *C-C* such is not the case, the initial guide bar pressure instead of being zero amounts to some 2,000 lbs. The maximum pressure occurs a little earlier, and varies greatly in value, being in the one case 12,000 lbs. and

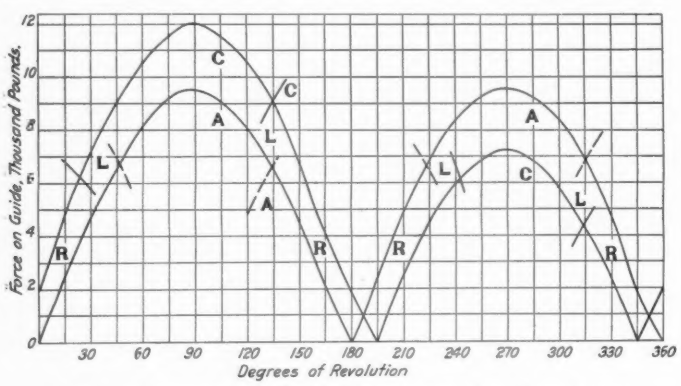


Fig. 10—Pressure on the Guides During One Revolution

7,300 lbs. in the other. Also the crank-pin instead of being at the back dead center when the guide bar pressure is zero, has moved up to 195 deg. In other words, the piston has started upon its return stroke, and when it has arrived within 15 deg. of the forward dead center the guide bar pressure again becomes zero and then increases to its approximate value of 2,000 lbs. at the end of the stroke. From this, it will be seen that, considering one side of the locomotive only, the effect resulting from the elevation of the cylinder center above the axle center is to cause the cross-head guide bar pressure instead of being similar and equal for the two strokes, to vary considerably in duration and amount, increasing some 25 per cent. on the inward stroke and decreasing by that amount on the outward stroke.

Referring now to the left side of the locomotive: The curves which would be identical are shown only where they cross the curves for the right side—this being done to avoid confusion—the broken lines corresponding to the curve *A-A* and the full lines to the curve *C-C*. To distinguish them, the letters *L* and *R* are inserted. The greatest upward pressure exerted on the right and left guides for the curve *A-A* is very uniform for the four quadrants varying between 13,200 lbs. at 135 deg. and 13,800 lbs. at 315 deg. For the curve *C-C*, however, the variation is considerably greater in the different quadrants, reaching a maximum of 18,200 lbs. at 135 deg. This amounts to an increase in upward pressure on the guides of 4,400 lbs., or about 32 per cent., due to the elevation of the center line of the cylinder a distance of 4 in. above the center line of the main driving axle.

To summarize briefly: The effect of raising the center line of the cylinder above the axle center is to vary the cross-head guide bar pressure during the inward and outward strokes and also to disturb the steam distribution. Raising the center line of the stroke diminishes the obliquity of the connecting-rod for the forward stroke, resulting in a decreased guide bar reaction, and increases the obliquity of the connecting-rod for the return stroke with a corresponding increase in guide-bar reaction. With respect to the effect of the raised cylinder center on the steam distribution, it alters the angularity of the main-rod which in turn influences the valve gear and also the turning effort on the crank pin. The higher the cylinder center above the axle center and the shorter the main-rod, the greater the variation in the steam distribution on the front and back side of the piston and the more difficult it becomes to design a valve gear that will give equal cut-offs, equal releases, and equal port-openings without sacrificing any portion of the other valve events. Eliminating the fact that a locomotive settles in service, and considering only the features included within the scope of this article, the best location of the cylinder center would be on a line intersecting the axle center. As to the main-rod, the longer it is (other things being equal), the less will be its angularity and the more even will be the turning effort on the crank-pin and the better the steam distribution.

Considering next the tangential forces acting on the crank-pin and referring to curve Fig. 11, the curve marked *RR* is seen to be similar to the one already developed and described in Fig. 10. The curves of Fig. 11 refer solely to the *AA* construction of Fig. 8, this construction being the one in which the center line of the cylinder intersects the center of the axle.

It will be noted that in Fig. 10 this curve has for its ordinates the values of the guide bar pressure in thousands of pounds, while in Fig. 11 the ordinates represent the tangential force at the crank-pin in thousands of pounds. At the right is a set of ordinates (approximately correct) having the values of the tractive effort in pounds; more will be said concerning this further on. The abscissas represent the degrees of revolution of the crank-pin or what is the same thing, the distance passed over during one complete revolution of the driving wheel, or feet of travel on the rail. Below the curve is a series of diagrams showing the positions of the right and left crank-pin for every 45 deg. of revolution; these lines connect into the abscissa line at their proper location.

Starting with the right crank-pin on the forward dead center, as shown in the diagram at the lower left-hand corner, it will be evident that the turning effort on the crank-pin will be zero. When the pin has turned through an angle of 15 deg., the turning effort will have reached a value of 21,000 lbs., as is indicated by the small circle on the curve. This value was determined as explained in Fig. 9. Similarly for 30 deg., the turning effort has reached a value of 41,500 lbs. at 90 deg., at which point the pin is on the lower quarter, the turning moment is very near its maximum value, and at 180 deg. it has again become zero, due to the fact the pin has reached the back dead center. For the remaining 180 deg., the curve is constructed in a similar manner.

From about 110 deg. to 180 deg. and from about 296 deg. to 360 deg. there are two branches to the curve *R*. The upper branch is for the 92 per cent. cut-off and the lower for the 70 per cent. cut-off, the piston being driven by the same initial steam pressure in each case as shown by the diagrams in Fig. 8. It will be evident that with the longer cut-off the mean effective pressure in the cylinder will be greater, resulting in a greater mean tangential pressure on the crank-pin. This, however, will not effect the values in the curve until after cut-off for the 70 per cent. diagram, since until this point has been reached the force on the piston is the same as shown by the diagrams in Fig. 8.

The curve marked *L* for the left cylinder is developed in a similar manner, but with one difference. Since the left main-pin follows 90 deg. behind the right pin, the two curves will vary in phase by the same amount; that is, with the right pin at its

forward dead center, resulting in a zero tangential effort, the left pin will be on its top quarter and exerting approximately its maximum tangential effort.

The effort curves for the right (*R*) and left (*L*) cylinders having been constructed, it is now possible, by superimposing one on the other, to construct a combined curve showing the total tangential effort at any point during one revolution of the driving wheels. This curve is accordingly plotted in the upper part of the diagram, and, as is the case with the lower curves, has two branches—one for the 92 per cent. cut-off, and the other for the 70 per cent. cut-off.

Referring again to the indicator diagrams, Fig. 8, it will be remembered that the maximum steam pressure was taken as 184 lbs., this being 92 per cent. of an assumed boiler pressure of 200 lbs. At 70 per cent. cut-off the mean effective pressure taken from the diagram will be 163.5 lbs., which, substituted in the standard tractive effort formula, gives a tractive effort of 43,950 lbs. Similarly a 92 per cent. cut-off results in a mean effective pressure of 179 lbs. and a tractive effort of 48,000 lbs. While by the customary method of assuming the mean effective pressure as 85 per cent. of the boiler pressure, the tractive effort amounts to 45,700 lbs. It will be noticed that this latter value is very nearly the mean of the other two, indicating that while the other two values were arbitrarily assumed they allow practically the same amount as the standard formula for friction, etc.

The difference between the tractive effort of 43,950 lbs. for the 70 per cent. cut-off and 48,100 lbs. for the 92 per cent. cut-off amounts to 4,150 lbs., or 9½ per cent., an increase in the average tractive effort, inasmuch as the values were figured from the mean effective pressure in the cylinders. It is well to note that the common fallacy exists in speaking of the maximum tractive effort when in reality this tractive effort is merely the average for a complete revolution. Referring to the 92 per cent. cut-off branch of the combined curve, Fig. 11, the maximum tractive effort for the quadrant *A* amounts to 58,800 lbs., while the average tractive effort determined from the formula for a 92 per cent. cut-off is 48,100 lbs. The difference between these values is 10,700 lbs., or approximately 22 per cent. For the same quadrant the minimum tractive effort is 38,200 lbs., or about 10,000 lbs. less than the average, and the difference between the maximum and minimum values for this quadrant is about 20,000 lbs. It will be noted that the points of maximum tractive effort for each quadrant occur with the pins on the eights and that the greatest value occurs with the pins on the forward eights, while with the pins on either the upper or lower eights the values are the same. The minimum values occur with the pins on the quarters and centers and in all cases are the same.

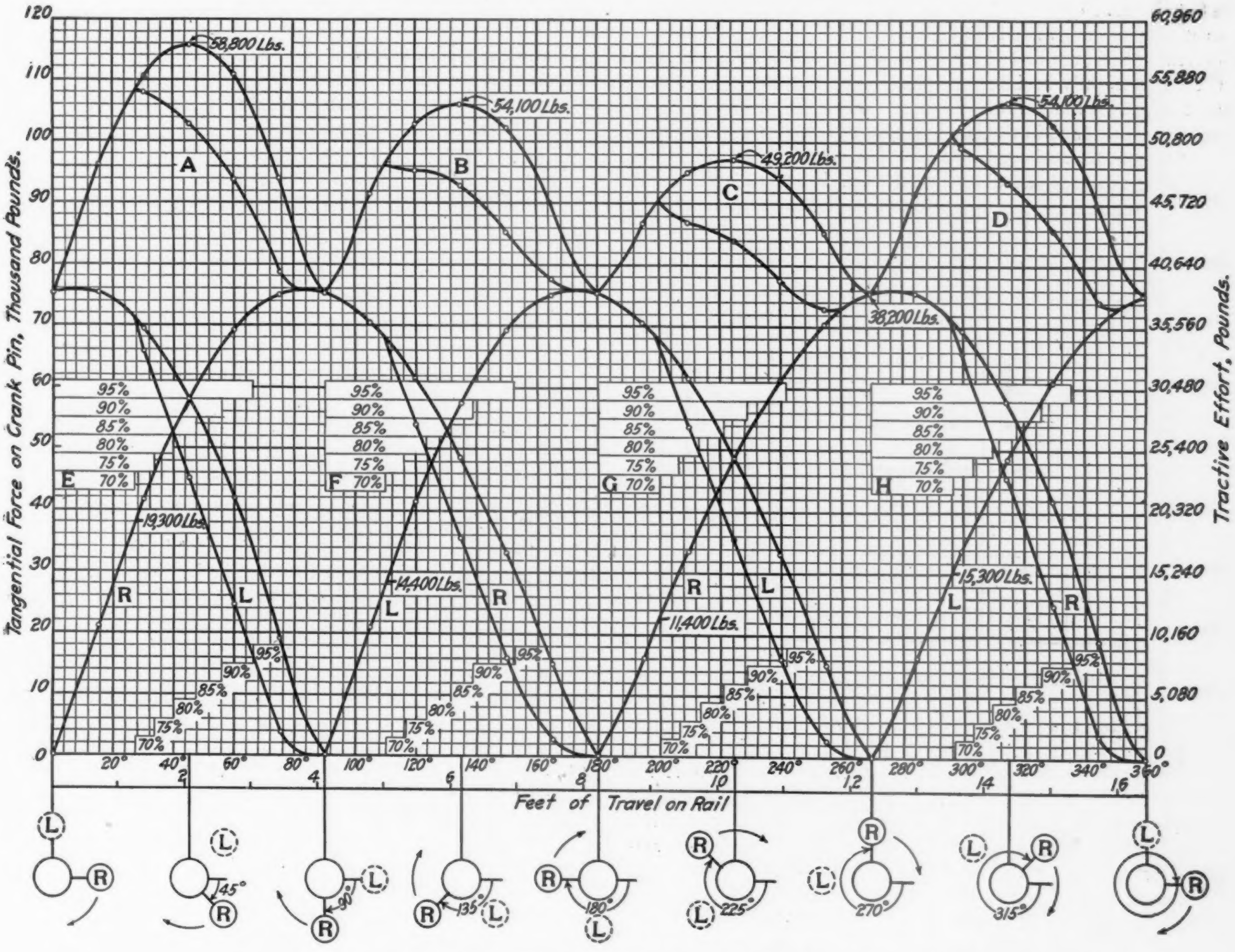


Fig. 11—Curves Giving the Tangential Force at the Crank Pin for the Full Revolution

In addition to the variation in the values of the maximum tractive efforts, the curves also indicate that there is some variation in the work performed in each quadrant. Since, like an indicator card, this diagram is plotted with the ordinates expressed in terms of force and its abscissæ as distances, its area represents work done and to obtain a measure of the work performed in each quadrant, it is simply necessary to integrate the area under each section of the curve and express it as a percentage of the whole. This was done and the following values found

for this diagram, which is constructed with the right main-pin starting from the zero position.

First quadrant	(A)	26¼ per cent.
Second quadrant	(B)	25 per cent.
Third quadrant	(C)	23½ per cent.
Fourth quadrant	(D)	25 per cent.

From this it will be apparent that, not only is the maximum tractive effort greatest, but also the highest percentage of the work is done in the first quadrant; also that the amount of work done in the second and fourth quadrants is the same, as near as can be determined.

The discussion relative to the diagrams in Fig. 11 has to do only with the case in which the center line of the cylinder intersected the center line of the axle.

Taking up the case in which the cylinder center is above the axle center 4 inches and referring to Fig. 12, the full line will at once be recognized as the upper line in quadrant *A* of Fig. 11. This quadrant only will be considered, since the results obtained in it will indicate what is to be expected in the other three. The dotted line shows that the raising of the cylinder center shifts the curve slightly in a horizontal direction but has not the practical effect on the values of the turning force at the crank-pin and the work done in the quadrant, that it did have on the guide bar pressure as explained in connection with Fig. 10.

Having analyzed the diagrams in Figs. 11 and 12, with repect

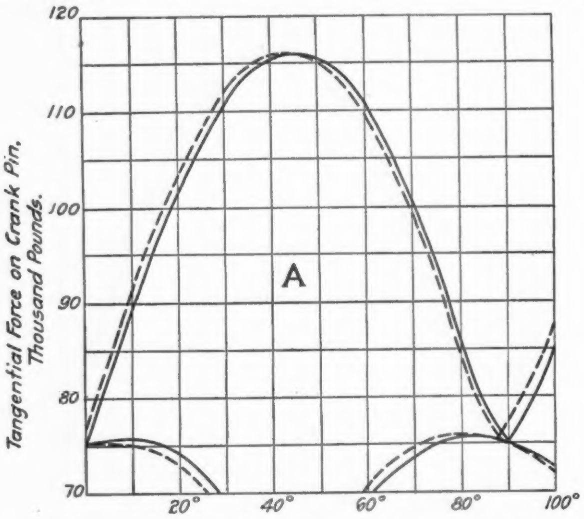


Fig. 12—Effect of Raising the Cylinder Center Line

to the variations in tractive effort and work done in the various quadrants throughout one revolution of the driving wheels at very slow speeds, and found that the average tractive effort for a 92 per cent. cut-off is about 9½ per cent. greater than that for a 70 per cent. cut-off, and that the raising of the cylinder center above the axle center has had but little effect on either the tractive effort or the work done, I will now consider to what extent the cut-off will influence the tractive effort the locomotive is capable of exerting at starting.

THE POSITION OF THE LOCOMOTIVE AT STARTING.

It will be readily perceived that when starting the valves may be so located that steam will be admitted to but one cylinder and that this condition will continue to exist until either the engine has been reversed or until part of a revolution of the drivers at least has been completed. This, in the estimation of the writer, is one of the features of locomotive design hitherto but little considered, but of great importance in meeting the present demands of heavy passenger service, and, in this connection, it is apparent that the three or four cylinder cranked-axle engine having cranks set at 90 deg. or 120 deg. may be so designed as to exert a greater starting effort than the ordinary two cylinder simple locomotive of equal adhesive weight. This will be better understood by referring to the diagram Fig. 11, starting with the zero point of the right cylinder curve in the lower left-hand corner. Steam will be admitted until the point of cut-off has been reached, which event in the case of the 70 per cent. cut-off takes place at about 110 deg. of revolution, and which will be recognized as the intersection of the two branches of the curve *R* just above the end of the blank space *F*. During this period, steam will also be admitted to the left cylinder until cut-off occurs, represented by the length of the blank space *E*, and also from the period of admission in the left cylinder until cut-off occurs in the right cylinder as indicated by the end of blank space *F*. The spaces *G* and *H* are similar for the other half of the revolution. The spaces *E, F, G* and *H* represent the period in one revolution during which steam is being admitted to both cylinders. The ratio of the total length of these spaces to the total length of the diagram indicates the percentage of time during one revolution that both cylinders will be taking steam, which in this instance is about 25 per cent. Inasmuch as we have considered a complete revolution, starting with the right main-pin on the forward dead center and continuing in a clockwise direction until that point has again been reached, it is evident that we have included every possible starting position of the locomotive. The practical lesson to be learned from the above lies in the fact that with a 70 per cent. cut-off the chances are one in four that both cylinders will be working steam at starting. This condition is improved somewhat by increasing the cut-off to 75 per cent., and still more so by an increase to 80 per cent., and practically overcome by an increase to 95 per cent., in which latter case the chances of working steam in both cylinders at starting are as 11 to 15.

This feature, while it is of importance in its effect on the starting power of a locomotive at rest, is of little consequence once it is in motion, since with the long cut-offs the steam confined in the cylinders after cut-off, due to the short period of expansion, does not undergo any serious drop in pressure.

As a practical application of this, we will examine to what degree the starting power of the locomotive under consideration will be affected in case but one cylinder is available for starting, which might easily be the case had one valve passed the cut-off position. This is aptly illustrated by the tractive value of 11,400 lbs., which is the maximum that the locomotive can exert when cutting off at 70 per cent. shortly after the beginning of the third quadrant, even though the locomotive is rated as being capable of exerting a tractive effort of 45,700 lbs. This results from the fact that at this particular instant the valve is so located that the left cylinder is closed to steam and the right cylinder only is serviceable. Had the engine been cutting off at 75 per cent., this value would have been 14,900 lbs.; at 80 per cent., 18,000 lbs.; at 85 per cent., 22,900 lbs.; at 90 per cent., 26,400 lbs., and at 95 per cent., 31,500 lbs., all of which values can be read directly from the curves by means of a scale of tractive efforts at the right of the diagram.

As an example of how "taking the slack," as we ordinarily say, overcomes this difficulty, it is apparent when we consider that should we change the position of the valves by reversing the engine, so that both cylinders would be open to steam, the tractive effort would then be the sum of both the right and left curves and would be increased from 11,400 lbs. to 45,720 lbs. This explains why, in many instances, locomotive engineers find it necessary to reverse the locomotive "take the slack" even when starting light trains with heavy locomotives and also why it is impossible in many instances to move a light locomotive until it has attained a considerable boiler pressure.

This condition can be remedied to a certain extent by exercising care in the design of the valve-gear and by proper attention at the shops and terminals. But by far the best remedy for this condition lies in the substitution of three or more cylinders.

INJURIES TO RAILWAY EMPLOYEES.—During the fiscal year ended June 30, 1913, 195 employees were killed and 3,361 employees were injured while coupling and uncoupling cars.

College Men and the Railroads

Interesting Views and Experiences Contained In Further Communications on This Subject

A number of letters on the subject of College Men and the Railroads were published in the Railway Age Gazette, Mechanical Edition, in the November and December, 1913, issues. These were written in reply to a communication on this subject which was published on page 523 of the October issue. Several others of the more important contributions that have been received follow:

FROM A COLLEGE GRADUATE WITH CONSIDERABLE RAILWAY EXPERIENCE WHO HAS FOUND IT ADVISABLE TO ENTER THE SUPPLY BUSINESS

I heartily agree with the substance of the letter appearing in your October issue entitled, "Why Don't Railroads Hold the College Men," and being intimately acquainted with one of the 90 per cent. who have left the railroad service for reasons differing in part from those set forth therein, perhaps the following will also be of interest.

Both in college and during vacations I made an effort to secure a general engineering education, as basic and broad as possible. On leaving college, a position of machinist helper was obtained in a western railroad shop, and in order of sequence, advancement to clerk, draftsman, construction boss, chief draftsman, and before the termination of three years the hoped for goal of supervising all technical work in the mechanical department was reached.

The scope of the work was large; the experience splendid. I have never regretted the years so spent. The discipline received and the knowledge gained of the operation of a large transportation system were alone invaluable. The wealth of information required of those holding responsible mechanical positions, the administrative ability expected and the untiring efforts exacted were eye-openers—not at first fully comprehensible to one who had heretofore been a student of other forms of industrial activity, *but*—

What ridiculous appropriations! What miserable salaries! Department efficiency was hampered in every branch. Important work in view accumulated to astounding proportions, and even that part labeled "rush" became cob-webbed with age. Good assistants were almost impossible to obtain at the prices offered, and only that portion who were fascinated by the ever moving wheels and life-like energy of transportation, or were tied by wives and families, remained.

So after examining with a microscope my monthly stipend, and carefully weighing all chances for better or worse I made a change.

Perhaps I should have been content to linger until my superiors experienced a change of view on the importance of the work done by the mechanical staff, or perhaps, more likely still, until the road attained that state of perfection, which appears so simple in legislative circles, when the lucre will flow from present rates like water. But there was another reason—the chief clerk to the superintendent—one of those mysterious and most wonderful creatures who dispose of 50 per cent. of the departmental work (whether they understand it or not) and assume 400 per cent. of the authority. For further information, I would refer to articles on the Hine system of organization wherein "chief clerk rule" is one of the evils abolished.

In my opinion these constitute sufficient grounds for terminating one's connection anywhere. But before closing I cannot refrain from criticizing your editorial relating to this subject and from offering a smile on the altar of the goddess of high salaries who is ever watchful over good mechanical men between the ages of thirty and thirty-five who have been faithful to our railroads. It would indeed be instructive if a summary of such mortals was available with properly compiled data showing length of service, present positions, remunerations, etc. It would give a good idea of the opportunities in this large and important field of endeavor. I fear that many of those who have been there and still have vivid dreams of cinders, grease, leaky flues, broken staybolts, engines in turntable pits and cars down embankments, are sadly in need of enlightenment.

FROM A CONSULTING ENGINEER, C. J. MORRISON

Referring to the communication in the October issue entitled "Why Don't Railroads Hold the College Man?" I believe the trouble is largely with the railroad organization. While there may be a great difference in the training which a college man receives in the shops on the various railroads, it is very noticeable that many of the men who have completed this preliminary course leave the railroads. This is largely for the reason that there is so little chance of advancement in the mechanical department. The railroads are so organized that a man very seldom rises from the mechanical department to the highest executive positions. This limitation means that a man must limit his ambition to the position of superintendent of motive power. This, on most railroads, is a comparatively poorly paid position which involves great responsibility and considerable hardship. Men in comparatively unimportant positions in commercial life receive higher salaries than many of the superintendents of motive power and have much easier working and living conditions.

To illustrate the situation, consider a few men who completed their preliminary course with the railroads and see what became of them. All of them graduated from well known universities at about the same time quite a number of years ago.

Two brothers graduated, three years apart, and both entered the service of the same railroad as special apprentices. The elder completed his course, held several minor positions and is today master mechanic at a small, unimportant point where living is a hardship. The younger brother, upon completion of his apprenticeship, was placed in the shop at a rate of pay a little lower than that of the ordinary machinist. He remonstrated and was told that he was not worth full pay as considerable of his time during apprenticeship had been spent on tests, inspection of material, etc., and therefore he was not a full-fledged machinist. He immediately quit, entered commercial life and is today earning more than twice as much as his elder brother. It is interesting in this connection to note that practically everyone considered the elder a more capable man.

A third man who was an apprentice on this same railroad, at about the same time, finally rose to master mechanic and is now superintendent of motive power of a small unimportant road where he has long hours, a great deal of responsibility and a very meager salary.

Still another man on the same road, at about the same time, finished his course and rose to position of assistant superintendent of motive power on another and larger road. From a railroad standpoint this was a splendid position, but as his ambition was not satisfied he left the road, entered a railway supply manufacturing business and is today president of his company.

A fifth college graduate on the same road finished his apprenticeship, and then went to another road where he is now engineer of tests at a salary of $225 a month.

As a final illustration consider another engineer who fought

the battle all the way through, going by successive steps through his apprenticeship through the positions of foreman, general foreman, superintendent of shops, until he reached the highest position which he could hope for in the mechanical department for many years. About this time a reorganization was made and an entirely new grand division was created. This division was placed in charge of a vice-president of the road who was to have two assistants. This vice-president was a friend of the engineer in question, and he was urged to appoint this man as one of his assistants. He was shown quite conclusively the advantages of having, as an assistant, a man thoroughly acquainted with all motive power problems, but he was afraid to break over the railroad precedent and appointed both of his assistants from the operating department. As this college graduate could not break through the railroad organization with the combined efforts of friendship and ability, and rise beyond the confines of the mechanical department, he left railroading and entered commercial life. Much to his surprise he was able to double his salary almost immediately, and to triple it inside of the year. Today he has ceased to work for a salary and is conducting his own business.

It would thus seem little wonder that college graduates should leave the railroads. In fact it is surprising that any should remain, when all who are capable can do much better outside. The railroads will not be able to hold these men until they break down the barriers and make it possible for men to rise from the mechanical department to the highest positions on the railroads. There are other disadvantages of the present railroad organization which I will not take the space to mention now.

FROM DEXTER S. KIMBALL, PROFESSOR OF MACHINE DESIGN AT SIBLEY COLLEGE, CORNELL UNIVERSITY, WHO HAS FOLLOWED THE CAREERS OF MANY COLLEGE MEN

The letter by I. I. W. and the editorial comments in the October issue interested me greatly because, taken together, they present the most difficult phase of vocational education. It is now very generally recognized that a certain part of vocational training can best be given in organized schools apart from industry, while it is also recognized that such schools have definite limitations so that their work must be supplemented after the boy or girl has entered industry, if the best results are to be obtained. Just where the dividing line between school and shop shall be drawn is at present not clear, though a solution in the near future seems probable.

It is now almost universally admitted that school training is almost essential to success in callings where scientific knowledge forms the background of the industry, and it is becoming more evident every day that, other things being equal, the man with a trained mind will outstrip the man who lacks academic training, *provided proper provision is made to adapt him to the industry which he enters.*

Employers for the most part have not fully grasped the importance of organized educational methods, not only in the case of the semi-trained man under discussion, but as regards the training of men of all kinds. In most shops today reliance is placed on the old methods which depended entirely on the initiative of the workmen. Under such methods it formerly required seven years for a boy to learn a trade which we know now could have been imparted to him in two or three years if teaching methods were pursued instead of the old methods whereby he obtained his knowledge and skill by methods of absorption. Employers and employees will do well to read the articles by Mr. Gantt* on this subject. Whatever may be the defects of so called scientific management, the theory of its advocates that it pays to teach men good methods is sound and in strict accord with all human experience. The employer who takes a college trained man into his employ and turns him loose in the shop, trusting to Providence that he may develop into a strong executive or designer, is not following out the plan that he would use to insure the education of his own children in the ordinary branches of learning. Systematic educational methods are essential to develop the fit as quickly as possible and to find the unfit at the earliest possible moment. This does not mean that the college trained man should not work. He should work and work hard; but he should work progressively; for if he is any good he will not be content unless he is making progress. The general tendency among employers that have had experience in this line is to make the period of adaptation as short and as progressive as possible, and the conclusions of I. I. W. on this point are undoubtedly correct.

Now it is evident that, as you point out, the more the college can do the less the shop will be required to supply. It is now universally admitted that only a small part of the practical experience which a successful executor or designer must possess can be acquired in college, and consequently the greater part must be obtained in practice after graduation. There is, however, as the editor's remarks imply, a certain amount of practical application of fundamental theory that can perhaps be imparted equally well either in college or in practice. The more of this practical application of fundamental theory is given in college the less need be given in the industry.

But, again, there are limitations to the amount of such application that the college can intelligently perform. When industry was simpler it was possible to arrange a course so that all students could get some applied work in nearly all of the important branches, which were then comparatively few. But the industrial field has broadened tremendously in the last twenty years. In the field of electrical engineering alone it is not now possible to carry applied theory beyond very general types and this difficulty grows apace in all fields, thus requiring a vast staff of specialists and equipment, if the school is to keep up with modern progress, and so costly as to be most usually beyond its financial resources. This problem is also rendered more difficult by the constant changes in industry. A field that is important today is of much less or of no importance tomorrow. The turbine greatly affected the steam engine field, the gas engine may considerably affect both, and the flying machine may change the manufacture of automobiles and ships.

On the other hand, it is an exceptional student who knows exactly what he wants to do as a life work, or who knows just what he is best fitted for. Nothing but a trial will, in general, decide this question. Care must be exercised therefore that men are not specially fitted for callings that are about to change or disappear, or specialized so closely that they cannot be adapted to some other callings in case of a change. In the lower grades of industrial education where preparation for the trades is the objective point this is one of the greatest difficulties in the way of the solution of the problem, and one that is going to have a profound effect on our public school methods of industrial education. It is no less important in the preparation of college-trained men.

It is because of these conditions that I believe that the trend of all vocational education is more and more toward the teaching of fundamentals and their application to general rather than to special fields, leaving a large part of the actual adaptation to the industry itself. The distance to which any school may go in providing special preparation for specific industries will, in my opinion, be largely a local one just as pure trade schools will be justified or not depending on the volume of business in the locality concerned. It may be very desirable to have special railway schools in some localities, special schools of aviation in another and schools of naval architecture in another. But, in general, I believe that the technical school of the future will concern itself largely with fundamentals, and the employer will make more careful preparation for adapting technical graduates so as to get best results from them in minimum time. The point of view held by I. I. W. is, therefore, timely and is worthy of careful consideration.

*See Work, Wages and Profits, by H. L. Gantt.

LOCOMOTIVE BOILER INSPECTION*

The Welding of Boiler Tubes; Interval Between the Tests of Steam Gages and Safety Valves

BY FRANK McMANAMY
Chief Inspector, Locomotive Boilers, Interstate Commerce Commission

The accident records show that during the year ended June 30, 1913, there was a reduction of over 60 per cent. in the number killed and 10 per cent. in the number injured by failures of locomotive boilers and their appurtenances, in comparison with the preceding fiscal year, or with any previous year of which a reasonably authentic record exists. The practice of conducting a rigid, searching investigation of all accidents to locomotive boilers and their appurtenances sufficiently serious to justify a report, with the sole object in view of determining the exact

Result of a Boiler Explosion Caused by Defective Crown Bar Braces

cause and having the proper remedy applied, has done much to reduce the list of casualties, and has directed attention to conditions which previously have been overlooked or ignored.

The following comparison of some of the most serious, as well as some of the most frequent accidents during the first and last quarters of the fiscal year ended June 30, 1913, fairly represents the benefits which result from government supervision over the condition of locomotive boilers and their appurtenances:

	First Quarter			Last Quarter		
	Accidents.	Killed.	Injured.	Accidents.	Killed.	Injured.
Crown sheet failures......	18	10	30	9	2	13
Flue failures.............	15	..	18	11	1	11
Injector steam pipe failures	10	..	13	5	..	6
Arch tube failures........	5	..	5	5	..	7
Water glasses bursting....	36	..	36	16	..	16
Lubricator glasses bursting	11	..	11	6	..	6

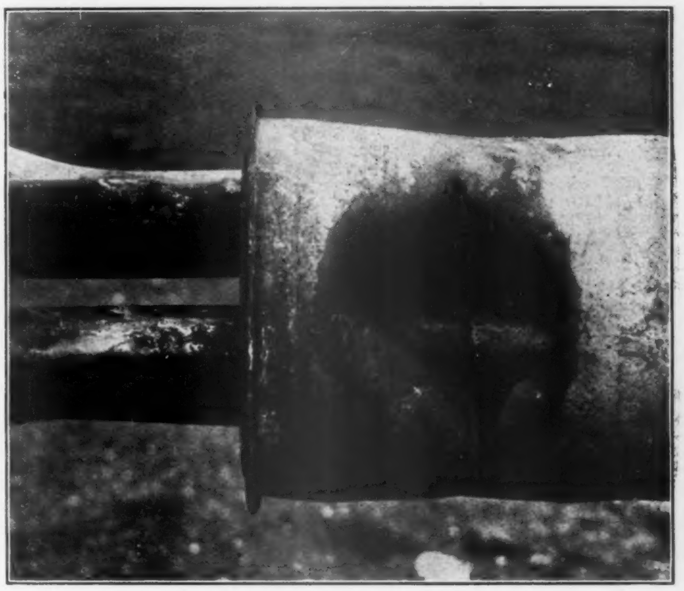
It will thus be seen that for the six classes of accidents referred to above which resulted in injury, 95 occurred during the first quarter and 51 during the last quarter. A better illustration perhaps of the improvement which has been brought about is that during the three months ended September 30, 1912, there were 95 accidents of the classes mentioned above, with 10 persons killed and 113 injured thereby, while during the six months ended September 30, 1913, there were 94 accidents with eight killed and 103 injured thereby.

A brief digest of some of the more serious accidents shows a very decided improvement on the whole, but there are certain classes of accidents where, instead of an improvement, conditions appear to have grown worse. One illustration of this is the arch tube failures. During the year ended June 30, 1912, there were 18 arch tube failures which caused injury, with none killed and 23 persons injured thereby, and during the year ended June 30, 1913, there were 20 arch tube failures which caused injury, with three killed and 27 injured thereby.

Investigation shows that of these 20 arch tube failures, 15 were caused by improper application or neglect, one showed evidence of both; three were reported to have been defective, and only one showed a clear rupture without evidence of improper application, neglect or defect in the tube. This proves conclusively that with proper attention 80 per cent. of these accidents could have been positively prevented. It will, no doubt, be urged that the increase in the number of locomotives in service which are equipped with arch tubes, may account for the increased number of accidents, but as it has been shown that four out of every five arch tube failures result from improper application or neglect, they can not properly be charged to the increased number of tubes in service.

Tightening washout plugs under pressure is a practice which has caused numerous accidents, and a peculiar fact in connection with it is that in a majority of such cases this work was being done with the boiler foreman or roundhouse foreman present, and either directing or performing the work. This class of accidents is positively preventable, and strict instructions should be issued and enforced never to put a wrench on a plug while there is pressure on the boiler.

Another type of accidents which has shown an increase during the past fiscal year is injector steam pipe failures. During the year ended June 30, 1912, there were 31 accidents of this type which caused injury, in which 38 persons were injured. During the year ended June 30, 1913, there were 36 accidents of this type which caused injury, in which 47 persons were injured.



Superheater Tube Which Collapsed from the Effects of Improper Treatment in Welding

In 24 cases the failure occurred where the collar was brazed on to the pipe and was due either to defective brazing or to the fact that the pipe or the collar was too thin at this point. This is a defective condition which could not readily be discovered by inspection, but the fact that such failures invariably occurred at the same point should have led to an investigation that would have disclosed the cause. In order that this condition may be properly remedied at its source, we have directed the attention of injector manufacturers and locomotive

*Abstract of paper presented before the Western Railway Club, December 16, 1913.

builders to this weak point, and they are at the present time earnestly striving through the efforts of a joint committee with which we are co-operating to have adopted a connection that will remedy the trouble.

Another class of accidents in which there has not been an improvement is flue failures. During the year ended June 30, 1912, there were 56 failures which caused injury, resulting in one killed and 62 injured, and during the year ended June 30, 1913, there were 54 failures which caused injury, resulting in one killed and 63 injured. More attention should be given to the welding, fewer welds should be made, particularly on flues for high pressure, more attention should be given to properly testing welded tubes, and a positive limit should be fixed for scrapping.

The question of flue failures, although important of itself, has been mentioned principally because it leads up to what to me appears to be a more important question that should at once be given serious consideration by the mechanical departments of the various railroads, and by the department of the government with which I am connected, and, that question is, shall superheater tubes be welded? To the men on locomotives, the collapse or failure of one of these large tubes amounts to about the same as a crown sheet failure, because in either case, death or serious injury is almost certain. Therefore, if we are to have the same number of failures of superheater tubes due to welding that we now have with the smaller tubes, the injuries resulting therefrom will on account of the size of the tubes doubtless be so much more serious that in the interest of safety, action will have to be taken possibly even to the extent of prohibiting welds in such large tubes.

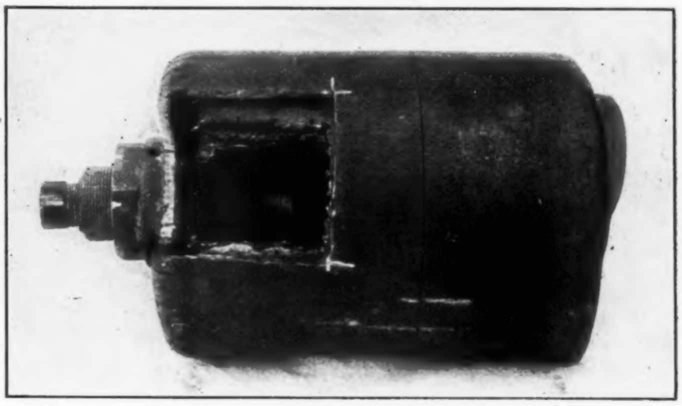
I am not making a positive statement that welds in superheater tubes will be prohibited, but that it is a matter which is being closely watched, and what action may be necessary will depend on future developments, because a large percentage of such tubes now in service are comparatively new and have never been safe ended. Many shops where this work is being done are poorly equipped for handling it, adequate tests of welded tubes are in many instances not being made, and, as might be expected, there is a wide divergency of opinion as to the best method of doing such work. That the strength of a weld is practically an unknown quantity has been demonstrated times without number, and, for this reason it is the generally recognized practice that where the highest degree of efficiency and reliability is required, welds are prohibited.

A short time ago the question was brought up by some of the railroads as to whether they would be required to remove superheater tubes once in three years in accordance with rule 10 which provides that "All flues of boilers in service, except as otherwise provided, shall be removed at least once every three years and a thorough examination shall be made of the entire interior of the boiler." It was urged that their superheater tubes should be exempt from that requirement on account of being welded in and also because their boilers could be entered, thoroughly cleaned and inspected as required by the rule, without removing the superheater tubes. To remove, so far as possible, the occasion for welding safe ends on these tubes, as well as for the reasons advanced by them, it was decided that: "Unless further investigation should prove that it is necessary to do so, superheater tubes need not be removed every three years, provided the tubes are in good condition and the boiler can be thoroughly cleaned and inspected without their removal."

Another question of considerable importance which has recently been decided, relates to the removal of brick work in oil-burning locomotives, for the purpose of hammer testing staybolts. When this question was taken up by some of the carriers, they were advised as follows:

"If staybolts which are behind brick work on oil-burning locomotives, or behind grate bearers, have a telltale hole 3/16 in. in diameter through their entire length which is kept open at all times, the removal of the brick work or grate bearers each month for the purpose of hammer testing, such bolts will not be required. This will not, however, relieve from making a thorough inspection each time the brick work is removed, nor will it relieve from removing the brick work for an inspection when necessary."

There still appear to be some requirements of the rules which are not fully understood, or, at any rate, are not properly complied with, to which I desire to direct your attention: One is that simply hammer testing staybolts does not by any means constitute a complete monthly inspection in accordance with the rules. Neither does the fact that a man has hammer tested the staybolts of itself place him in possession of all the necessary information to enable him to properly certify to the inspection report, yet we find many instances where the man who tested the staybolts certifies to the report when he has gone to some other point before the other work shown on the report was done, and as a matter of fact he does not know that it was ever done. Every item that is shown on the monthly inspection report is a part of the inspection and must be performed in accordance with the rules; washing the boiler, cleaning gage cocks and water glass cocks, testing and repairing injectors, repairing steam leaks, and inspecting arch or water bar tubes, which can only be properly done when the boiler is washed, are just as much a part of the monthly inspection as testing the staybolts and should be performed at the time the monthly inspection is made, and the man



Casing of a Safety Valve Which Caused an Explosion. Pipe Wrench Marks Show on the Adjusting Screw, Which Is Screwed In Too Far

or men who certify to the inspection report must have knowledge that such work has been performed.

There also appears to be some doubt in regard to the proper construction of rules 30 and 36, relative to the interval between steam gage and safety valve tests. This period is assumed by some to be anywhere between 90 and 120 days. This is a mistake. In order that there should be a certain degree of flexibility in the rules, they were made to read that this work should be done at least once every three months, which means approximately 90 days. The proper time to test steam gages and set safety valves is each third inspection, and it should be done at the time the inspection is made so that it may be properly certified to on the inspection report. If the monthly inspections are made at the required periods, they will automatically take care of the interval between the quarterly inspections.

Another matter that has not always received the consideration that it should is the location of the bottom water glass fitting. The opening to the boiler for this fitting should always be above the highest point of the crown sheet. The necessity of carefully checking the location of water glasses and gage cocks was forcefully demonstrated a short time ago when one of our inspectors found ten new Mikados which had just been received from the builders and placed in service with the lowest reading of the water glass just below the highest point of the crown sheet.

As a means of reducing the number of plugs to be removed when boilers are washed, the practice of blanking washout openings appears to be meeting with considerable favor on some roads. I believe the statement that more boiler failures are due to poor washing than to any other one cause can be demonstrated, and that there is no other way in which the mechanical department of any railroad can lay up so much future trouble for itself at such a small saving as by slighting the washing of boilers. The matter of blanking washout openings will be watched as closely as possible, and when sheets begin to show indications of distress vigorous action will be taken.

A summary of the inspection work performed by the Division of Locomotive Boiler Inspection during the year ended June 30, 1913, discloses the following:

Number of locomotives inspected	90,346
Number found defective	54,522
Number ordered out of service	4,676

The number of locomotives found defective does not indicate that these locomotives were found to be in violation of the law, but they were found to contain defects which should be remedied before the locomotives were again placed in service. The number found in direct violation of the law is represented by the number ordered out of service in accordance with Sec. 6 of the law, which requires the district inspectors to issue a written order holding the locomotive for repairs when one is found that does not meet the requirements of the law or rules. No formal appeal from the action of any district inspector has been filed during the year. This, in view of the vast amount of work performed and the number of locomotives on which repairs were ordered, shows that while the inspectors have been diligent, they have also used discretion and good judgment in the enforcement of the law. It is believed that it also shows the existence of a spirit of co-operation and an earnest effort to comply with the requirements of the law on the part of a large majority of railroad officers.

DISCUSSION

The interest taken in this paper was manifested by the manner in which it was discussed. All important points brought out were well received by the members present. Some roads seem to still find trouble in obtaining a suitable apparatus for squirting cold water, although the Lake Shore is using a device that seems entirely satisfactory. The steam pipe connection to the injector was also carefully considered and thoroughly discussed. The members of the club were told that a committee of injector manufacturers and railway mechanical men met with William Dalton, chief engineer of the American Locomotive Company, last June and were carefully considering this question. The report of their findings will probably be presented before the Master Mechanics' Association next June. The trouble seems to be mainly due to improper brazing at the injector, and a lack of bends in the steam pipe to allow for expansion and contraction. It is necessary that this connection be carefully watched, as the results from a failure are almost always very disastrous.

The question of safe-ending superheater flues was also considered. The Chicago, Burlington & Quincy is welding the safe ends on these flues by the oxy-acetylene process and reports very good results. Many members expressed the opinion that under the water conditions in and around Chicago the superheater flues would not last more than one or two years, while others contended that those flues welded into the rear tube sheet and kept in a clean condition would last three years or more. The Lake Shore reported over 200,000 miles for superheater tubes which were provided with copper ferrules beaded over and welded in the tube sheet. That road is also safe-ending these tubes with the Bradley hammer with success.

All were unanimously of the opinion that it was most hazardous to tighten up washout plugs while the boiler was under pressure, and undoubtedly greater precautions will be taken to see that this is never done.

Concerning the maintenance of arch tubes, it was clearly brought out that extreme care must be exerted in keeping them clean. One road adopts the method of scrapping them according to their weight, which seemed to meet with the approval of Mr. McManamy, providing the scrapping weight was conservative and that strict adherence was made to the standard. The Lake Shore rolls the arch tubes into the boiler heads and cleans them with a turbine cleaner at every boiler washing.

In closing Mr. McManamy, in replying to a remark that 2 in. tubes had been welded successfully so many years that there should be no reason for not welding the 5½ in. flues as successfully, said it was the desire of the department of boiler inspection that these large flues be welded decidedly better than the 2 in. flues, for a failure of one of the large flues would be much more disastrous than the failure of the small tube, and the records show that there are a number of small tubes failing. He also intimated that the future rulings or decisions as to whether any weld should be used in superheater flues will be largely governed by the way in which they act within the next few years. As the application of superheaters to locomotives in large numbers has taken place only during the past few years there has not been much necessity for safe-ending these large tubes, and one only has been brought to the attention of the commission. He stated that while a weld as a safe proposition was rather questionable, the burning of the metal either side of the weld seemed to cause the greatest number of failures. He clearly pointed out that the steam gage and safety valve tests should be made at every third inspection, which means every 90 days, and that these tests should be made during the time of the monthly boiler inspection.

LOCOMOTIVE DESIGN DURING 1913

The past year has brought important but not spectacular developments in locomotive progress. There has been much concentration on more effective use of fuel through fuel saving devices and capacity increasing factors and a marked tendency toward maximum power per unit of weight has developed. The important and helpful tendency toward co-operation on the part of engineers of the supply interests should be recognized and is being encouraged.

In a general way, the progress can be indicated and the present situation demonstrated by the following:

(1) Locomotives of the largest size for the different classes of service continue to be built almost exclusively. A beginning has been made toward applying the most economical arrangements and proportions to the lighter locomotives.

(2) Boiler capacity per pound of metal in the boiler has been decidedly increased by the use of larger fireboxes and combustion chambers, thus giving time for the completion of the gas reactions before the flues are reached. Shorter flues, giving a higher rate of evaporation per unit of area, are the result in some cases. Flues, however, in no case, are shortened from the front end and, having the size of firebox and combustion chamber desired, the flues are made as long as the weight limits will permit.

(3) Cylinders are increasing in relative size due to the lower steam consumption at shorter cut-offs when using superheated steam. Stokers are also causing enlarged cylinders because of the increase in the maximum boiler capacity.

(4) Heavier weights are being placed on drivers in connection with the lighter weights of reciprocating parts.

(5) Superheaters and brick arches are almost universally applied to new locomotives and are also being installed on many older designs.

(6) Standardization of the parts most frequently requiring repairs and the use of these parts on new locomotives as far as possible, is being more widely practiced.

In these days of diminishing and disappearing net earnings, higher average train loads must be handled. Locomotives are now being called on for results which but a few years ago would

have seemed absolutely impossible. The locomotive designers are meeting the demand and are producing Atlantic type locomotives which do as much work and haul as large trains as the Pacific type did two years ago; consolidations which perform the service that demanded Mikados in 1911, and all classes which will pull from 10 per cent. to 30 per cent. larger trains on the same amount of coal used two or three years ago. At the same time, if allowance is made for increases in wages and the increased cost of material, the cost of repairs per unit of work has been actually decreased.

The general use of the superheater and brick arch is largely responsible for this improvement, but the adjusting of all parts to the best relationship, one with the other, has been effective in continuing the improvement.

In general the problem has been to obtain the greatest drawbar pull at the highest practical speed for the service with the least total weight of locomotive. Sustained drawbar pull depends mostly on boiler capacity, and in this direction great strides are being made. While the ratio of output in steam to the weight of the boiler is increasing, still the total weight of the boiler also continues to increase. This, in turn, means greater weight on the wheels, most of it coming on the drivers. In high or moderate speed service the permissible dead weight on drivers is controlled by the hammer blow of the excess weight in the counterbalance which is controlled by the weight of the reciprocating parts. The weight of these parts is dependent on the amount of power delivered by the cylinders, and thus the cycle is complete.

While there has not actually been built this year a locomotive which exceeds in total weight the 2-10-10-2 type built by the Santa Fe in 1911, which weighs 616,000 lb., or the Virginian 2-8-8-2 type built by the American Locomotive Company in 1912, which weighs 540,000 lb., still the average weight of new locomotives built continues to increase. Selecting ten typical examples of the 2-8-2 type built during the year, the average total weight is 293,020 lb. The average for ten Pacific type engines is 273,130 lb., and for four typical consolidations the average weight is 246,875 lb.—*Railway Age Gazette.*

RAILWAY ACCIDENTS AND THEIR CAUSES

During the year ending June 30, 1913, a total of 76 train accidents were investigated by the Interstate Commerce Commission. These accidents comprised 51 collisions and 25 derailments, and caused the death of 283 persons and the injury of 1,880 persons. The collisions investigated were responsible for 221 deaths and 1,174 injuries, and the derailments caused 62 deaths and 706 injuries.

The commission again is compelled to note the exceedingly large proportion of train accidents due to dereliction of duty on the part of employees. Fifty-six of the accidents investigated during the year, or nearly 74 per cent. of the whole number, were directly caused by mistakes of employees. These mistakes were of the same nature as those noted by the commission in its last annual report, namely, disregard of fixed signals; improper flagging; failure to obey train orders; improper checking of train register; misunderstanding of orders; occupying main track on time of superior train; block operator allowed train to enter occupied block; despatcher gave lap order or used improper form of order; operator made mistake in copying order; switch left open in face of approaching train; excessive speed; failure to identify train that was met.

These errors are exactly the ones which figure in the causes of train accidents year after year. Their persistence, leading always to the same harrowing results, points inevitably to the truth of one or the other of the following alternatives: Either a great majority of these deplorable railroad disasters are unavoidable or there exists a widespread lack of intelligent and well-directed effort to minimize the mistakes of employees in the operation of trains. It is not believed that all those accidents which are caused by the mistakes of employees are unavoidable. It is quite true that man is prone to error, and as long as absolute reliance is placed upon the human element in the operation of trains accidents are bound to occur, but until it can be shown that all reasonable and proper measures have been taken for its prevention no accident can be classed as unavoidable.

All of the mistakes noted above are violations of simple rules, which should have been easily understood by men of sufficient intelligence to be entrusted with the operation of trains. The evidence is that in the main the rules are understood, but they are habitually violated by employees who are charged with responsibility for the safe movement of trains. The evidence also is that in many cases operating officers are cognizant of this habitual disregard of rules and no proper steps are taken to correct the evil. Many operating officers seem to proceed upon the theory that their responsibility ends with the promulgation of rules, apparently overlooking the fact that no matter how inherently good a rule may be, it is of no force unless it is obeyed. On very many railroads there is little or no system of inspection or supervision of the work of train-service employees so far as pertains to those matters which vitally affect safety. Employees are not examined on the operating rules except at the time of their promotion, and only the most perfunctory efforts are made to determine their fitness to perform the duties assigned to them from time to time.

This lack of supervision and inspection with respect to matters affecting the safety of trains is unexplainable when the careful supervision of all matters directly affecting the revenue of the roads is considered. The auditing and checking systems used for detecting the dishonesty of employees are marvels of ingenuity and careful attention to detail, but means of determining whether trains are operated in accordance with the requirements of safety and in conformity with the rules are almost entirely lacking. Road foremen are employed to supervise the work of enginemen and to instruct them in their duties, but such supervision and instruction pertain mainly to matters affecting the proper working of engines so as to economize in the use of fuel, oil and other supplies; instruction on the rules is either entirely neglected or made secondary to matters of economy. Instruction in the use of the air brake is quite general, but this, again, is mainly for the purpose of improving practice in the direction of economy by eliminating shocks and break-in-twos in the handling of trains, thus reducing the money loss caused by damaged equipment and lading. The prevention of accidents by a strict observance of operating rules means not only the saving of human life, but of large sums of money as well. It would seem, therefore, that adequate inspection and supervision of the work of employees to insure safety in operation would be amply justified from the standpoint of economy alone.

In previous reports the commission has recommended legislation requiring the standardization of operating rules. It is vital to the safe movement of trains that rules should be explicit and uniform in character, so that they may be easily understood and that there may be no doubt as to their application. To this end Federal legislation is necessary. Such legislation also should require proper supervision of employees, to insure that the rules are obeyed, as well as systematic instruction and examinations at stated intervals to make certain that no employee is permitted to be in a responsible position unless he is thoroughly familiar with his duties and competent to perform them.—*Annual Report of the Interstate Commerce Commission.*

CAR DEPARTMENT

SAND BLAST FOR CLEANING STEEL CARS

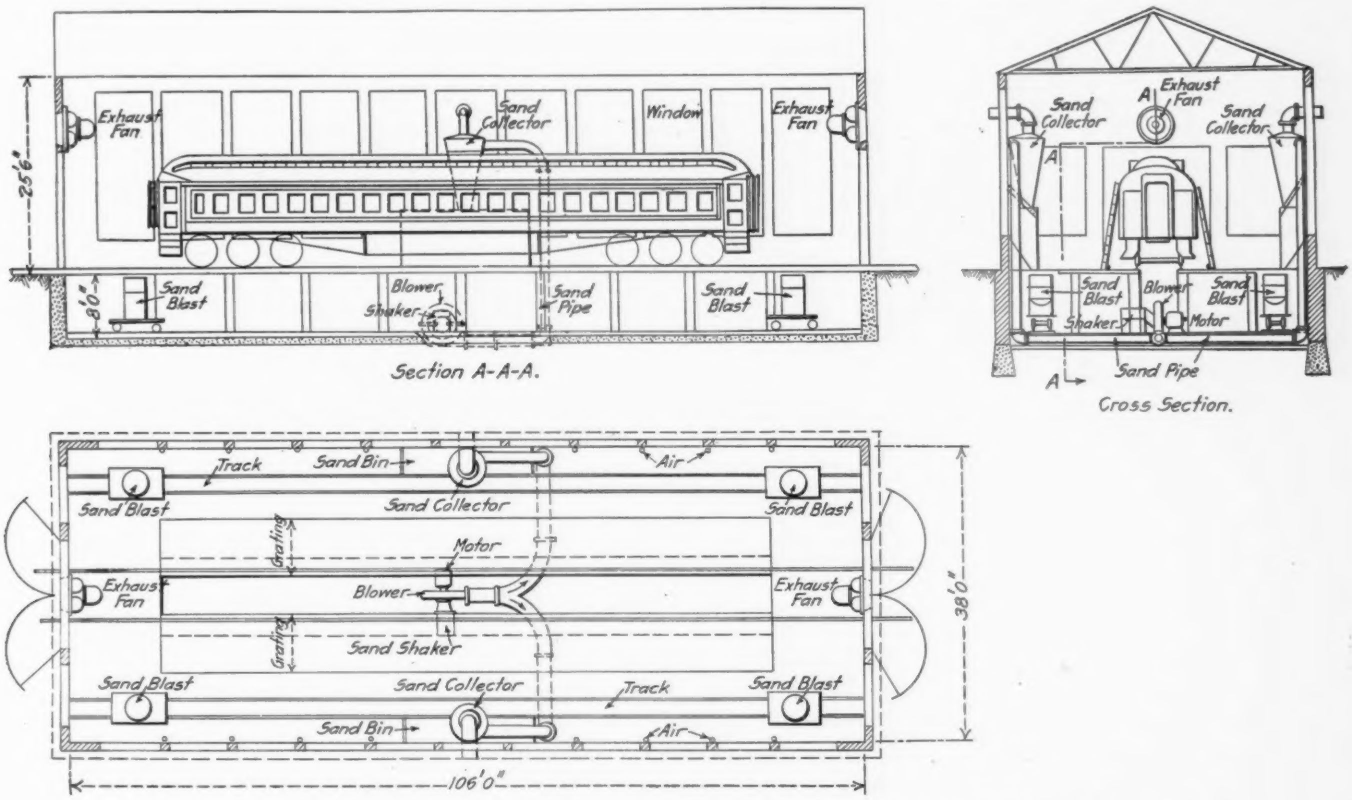
BY J. M. BETTON*

With the rapid increase in the number of steel cars it became necessary to provide means for removing the old paint from their surfaces, as well as to prepare them for a new covering. The sand blast is generally admitted to be the most efficient and economical means of accomplishing this, and special structures are needed as adjuncts to the railroad shops to enable this work to be done continuously and without interference with other work. The two arrangements shown in the illustrations were prepared to meet the demand for a separate sand blast cleaning shop.

Each shop is 106 ft. x 38 ft. inside and 25 ft. 6 in. in height, giving ample room for sand blasting an 80 ft. steel passenger coach or two 40 ft. steel box or gondola cars placed on a track extending through the building. The building may be built of stone, brick, concrete, or with a steel frame covered with corrugated iron. The sides and ends are well provided with windows, giving ample light, which is very essential to obtaining the best results both in quality of work and time. These windows are screened on the inside with No. 10 window netting to stop the fine flying gravel.

The cleaning shop should be located to leeward of the paint shop with respect to the average prevailing winds, to obviate any trouble from the distribution of fine dust, and at such a distance as to permit of the cleaned car passing to the point of painting as quickly as possible.

One of the illustrations shows a pit 8 ft. in the clear with concrete floor extending under the whole building, and over this at the floor level is a line of standard gage track. On each side of the central track is a grating, preferably of wrought iron bars 1½ in. x ½ in. with ⅝ in. spaces, extending from end to end and supported by concrete piers, two lines of which also support the central track. Along each side of the building is a line of 24 in. gage industrial track, the ties set in the concrete flooring, each line carrying two or more flat cars upon which sand blasts are mounted. There are four 36 in. x 36 in. Drucklieb injector sand blasts, each of 2,000 lbs. capacity and weighing when filled about 2,900 lbs Each of these is mounted on a four-wheel flat car of two tons capacity with a wooden top, cast steel wheels and roller bearings. Each sand blast is provided with 10 ft. of 1¼ in. rubber air hose with couplings, two 25-ft. lengths of 1½ in. delivery hose, nozzle holders, 100 steel nozzles, two sand blasters' helmets and the necessary connections for a single line of hose. Connection with the air piping is made at convenient points along the side walls. Each sand blast may be operated through one or two nozzles, as required, enabling four or eight men to work at the same time.



Arrangement of Building and Equipment for Cleaning Steel Cars by Means of a Sand Blast

The nozzlemen work from the grating at the level of the track and reach the upper parts of the cars by means of light ladders, running on an angle iron secured to the grating. The bottom of the car may be reached from the pit below.

The sand falls through the grating to the floor of the pit, upon which it is collected by means of wide hand scrapers or scoops, such as are used by street cleaners, and brought to the sand shaker, into which it is shoveled. The good sand is held on the shaker and delivered to the blower, which carries it up to the sand collector. It then falls through the collector to the sand bins, and is spouted into the sand blasts

*26 Park Place, New York.

as required. The upper screen of the shaker holds back scale, stones, etc., and the dust and fine sand of no value fall to the ground and are removed as they accumulate.

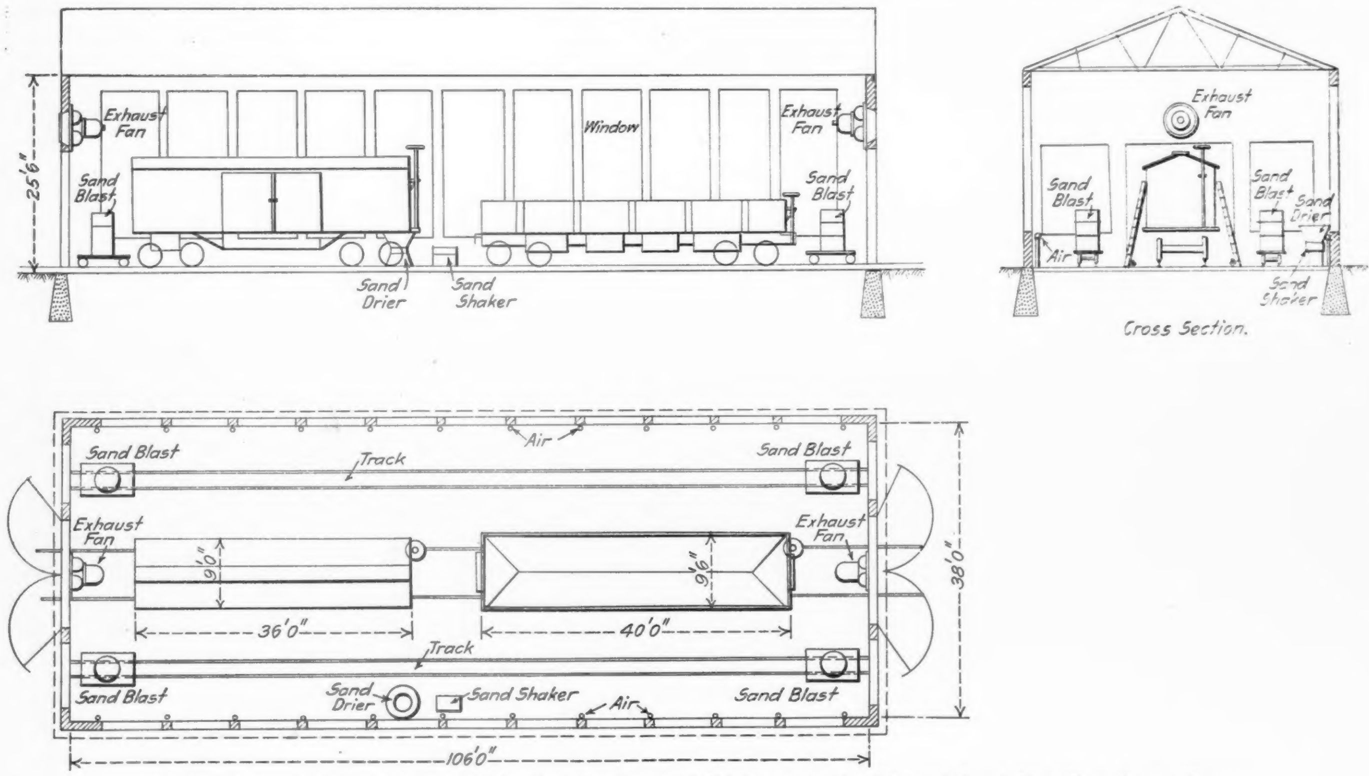
A No. 7 Buffalo blower is used, with 14 in. inlet, and should provide 5 oz. pressure at 1,800 r. p. m. It is run by a 10 h. p., d. c. 230 volt electric motor.

There are two 14 in. Buffalo sand collectors, with 14 in. outlet leading outside of the building to discharge any dust entrained with the sand. The diameter of the shell is 56 in. and the length 96 in. Two sand bins of riveted steel, No. 16 gage, are provided, each 17 ft. long, 3 ft. 0 in. wide, 4 ft. 0 in. deep at the rear and 8 ft. 6 in. deep in front, with three 4 in. sand gates. These are supported by the walls and from below. The capacity of each bin is 17 tons. The breeches pipe connecting the two lines of piping to the blower is provided with gates, enabling either side to be used at will. This piping is laid below the floor level to avoid the sand blast tracks. The blower acts as an auxiliary dust exhaust.

where there is a tee and a vertical drop pipe with a cap and 1 in. drain cock to catch any water condensed in the piping. There are risers from this pipe between each window, fitted with a 1¼ in. straightway cock and a quick attaching hose coupling. Additional storage bins for wet or dry sand may be arranged as convenient in the pit.

The sand blasts work under 30 lbs. air pressure per square inch with ½ in. nozzles, requiring 1,288 cu. ft. of free air per minute. The air compressor may be of any type capable of delivering 1,300 cu. ft. of free air per minute continuously under an even pressure of 30 lbs. per square inch. It should be of about 130 h. p., and may be driven by steam or belt; it should never be located in the sand blast shop.

The air receiver should be of ample capacity to insure a steady and even flow of air. The sand used should be good hard, sharp, bank or beach sand or gravel, about No. 8 mesh (⅛ in. square) and must be thoroughly dried before using. It can be used a number of times before becoming too fine



A Simpler Arrangement of Sand Blasting Equipment Which Omits the Pit and Sand Handling Apparatus

There are located at each end of the shop above the doors, a 48 in. Buffalo disc exhaust fan, operated by a d. c. electric motor. Each fan has a capacity of 18,000 cu. ft. of air per minute. The cubic contents of the building shown are approximately 150,000 cu. ft. and these two fans will change the air about every four minutes. By closing the doors and opening a window on each side in the middle of the building, currents of air will be established from the center to each end, drawing off the dust suspended in the air. With open doors and windows, and no objection arising from adjacent shops, the shop can be ventilated without exhaust fans.

A sand shaker provided with two sieves and operated by either electric motor or compressed air is included. The upper sieve is No. 8 mesh, and is provided with handles with which it may be removed to throw out stones, scale, old paint, etc. The lower sieve is No. 30 mesh and delivers the good sand through a suitable trough to the blower. The sand drier is located in the pit at any convenient point. The drier should have a capacity to dry 10 tons of sand per day.

A 4 in. air main is laid along each side of the building below the windows. It drains from each end to the center,

for effective work. The consumption of sand will be about one ton per hour.

The arrangement shown is designed for operation by one foreman, eight nozzlemen and two sand men, for drying and screening the sand and refilling sand blasts, a total of 11 men.

This provides a simple and effective outfit for the quick and thorough cleaning of any steel cars. The dimensions of the building may be slightly altered and the arrangement of the apparatus changed, but it will be found that too much room has not been allowed and that the central arrangement of the sand handling apparatus will give the best working facilities. If additional capacity is needed, an arrangement of cleaning tracks, either parallel or radiating, as in a roundhouse, will be found preferable to extending a single track, owing to the better facilities for ventilation.

The other illustration shows a similar arrangement along more simple lines, the principal difference being in the omission of the pit and the sand handling apparatus. It is estimated that the necessary labor for operating this shop would include one foreman, eight nozzle men and three sand men, a total of 12 men when working at full capacity.

ROLLER BEARINGS ON COACHES

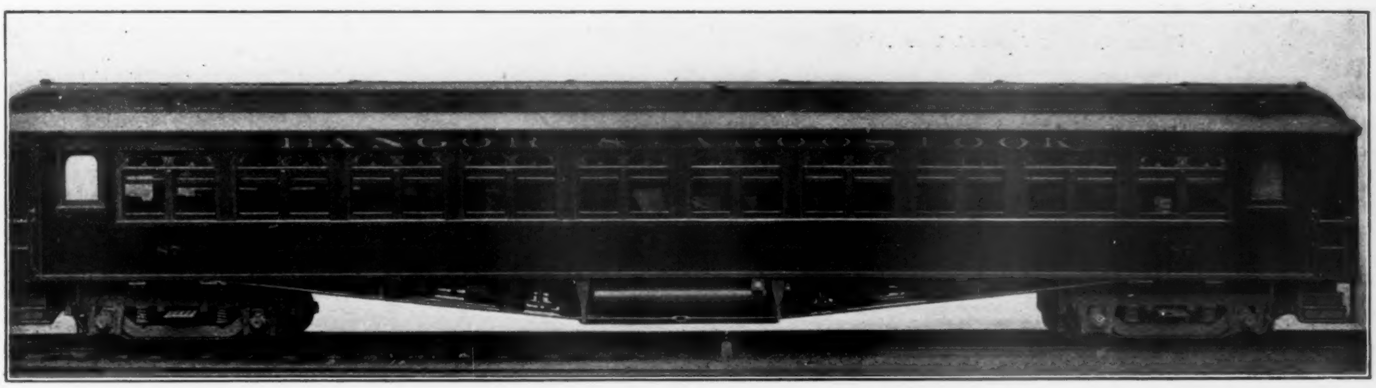
Standard 70 ft. Coaches and Interurban Cars Show Reduced Resistance and Low Maintenance Cost

It is not infrequently necessary to put a second locomotive on a heavy passenger train for the purpose of supplying extra power for starting and during acceleration, both for station stops and for the probable block signal stops or slow downs. Many late trains have been caused by the time lost in slow acceleration following an unusual number of stops or slow downs from signal or other causes. Tests that have been made in the past indicate that journal friction becomes a continually more important factor of the total resistance as the speed is decreased, and the wish has many times been expressed that it might be possible to apply anti-friction bearings to heavy passenger cars and thus allow the normal reserve capacity of a locomotive of suitable size to maintain the schedule under ordinary conditions, to take care of the unexpected slow downs. In addition the reduced resistance of the train at any speed would be an assistance to the same end. Until a comparatively recent time such a construction has not seemed feasible. The continual pressure on those studying the problem, caused by the increased weight and carrying capacity of automobiles, aided by the development of heat treatment of metals and the improved material that can now be obtained, has brought roller bearings to a degree of perfection that makes them a possibility for general application to freight and passenger cars. As proof of this, an example of a 74 ft. coach with a seating capacity of 84 and a weight of 91,200 lbs. which has been in regular service on the Bangor & Aroostook for nearly two years, can be cited. During this time no faults of any kind have developed in connection with the bearing and the riding qualities of the car have been materially improved. It has been found that this car starts more smoothly, coasts more freely, stops easier, accelerates faster, and racks the car and truck less than does the plain bearing. In addition the oiling and maintenance costs have been materially reduced.

Before making an application to a full sized standard steam railroad coach, a long series of experiments were made on lighter rolling stock. In August, 1902, the Standard Roller Bearing Company of Philadelphia applied roller bearing journals under a single truck street car operated by the Syracuse Rapid Transit Company. This car was, of course, very light, but it ran for six years without repair or replacement so far as the bearings were concerned. During this time it made a mileage of over 250,000 miles. During the same period other cars of the same type, operated on plain bearings, had their bearings renewed ten times at a total cost of $20 per wheel. In February, 1906, the same company made an application of roller bearings to a Strang gas-electric car. This car has a weight of 80,000 lbs., and is capable of speeds up to 65 miles an hour. During the first two years' service this car ran 175,000 miles and required absolutely no attention to the bearings except lubrication. These bearings are still in service and are in as satisfactory operating condition as when installed nearly eight years ago.

On the basis of the experience with these equipments, the design was further improved and refined, and in July, 1910, roller bearings were applied to a 25-ton interurban car operated by the Lehigh Valley Transit Company between Philadelphia and Allentown, Pa. Since that time other similar cars on that line have been equipped and sixteen cars with roller bearings are now in regular service. Six of the heavy, Pullman type cars are on high speed schedules and make an average of about 6,000 miles per car per month and are now running about 85,000 miles on three pints of oil. Experience with this equipment indicates that inspection once in 15,000 to 20,000 miles will be sufficient. The cars weigh about 80,000 lbs. without passengers.

Some similar cars on the Philadelphia & Western Electric Line have been subject to a comparative test between the roller bearing cars and those having plain bearings. These tests showed a power consumption of 6.2 kilowatt hours per car mile for the plain bearing cars and 5.2 kilowatt hours per car mile for the roller bearing cars, a saving of approximately 17 per cent. A test was also made of the flange wear in the two cases and a checking of the shape of the wheel tread and flange by taking plaster of paris impressions after 30,000 miles in both cases, indicated that the roller bearing equipment reduced the amount of flange wear. Casts which will be made at the end of the next 30,000 miles service will probably give more positive results on this feature.



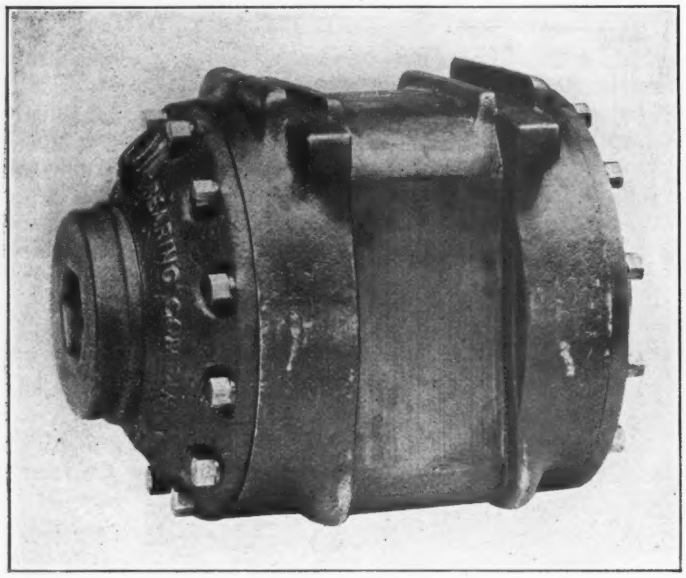
Passenger Coach on the Bangor & Aroostook, Equipped with a Full Set of Roller Bearings

Annular ball bearings have been very successful on light weight equipment, and at the present time there are 49 storage battery streets cars provided with ball bearings in service in New York City. Applications have also been made by the Hess-Bright Manufacturing Company, Philadelphia, Pa., to a number of heavy interurban cars. The first one was made in 1908 on a 40-ton electric car on the Atlantic City and Shore Railroad. This equipment is still operating satisfactorily, and there is every reason to believe that it will continue to do so for several years. Following that application, others were made, and all have given satisfactory results, although ball bearings have not, as yet been adopted as standard by any electric railway company, save for battery car operation.

The method of application of ball bearings is the same in all cases, namely, that two ball bearings, each a complete unit, are used in each box, one inside the pedestal jaw, and one outside.

A typical construction is shown in one of the illustrations.

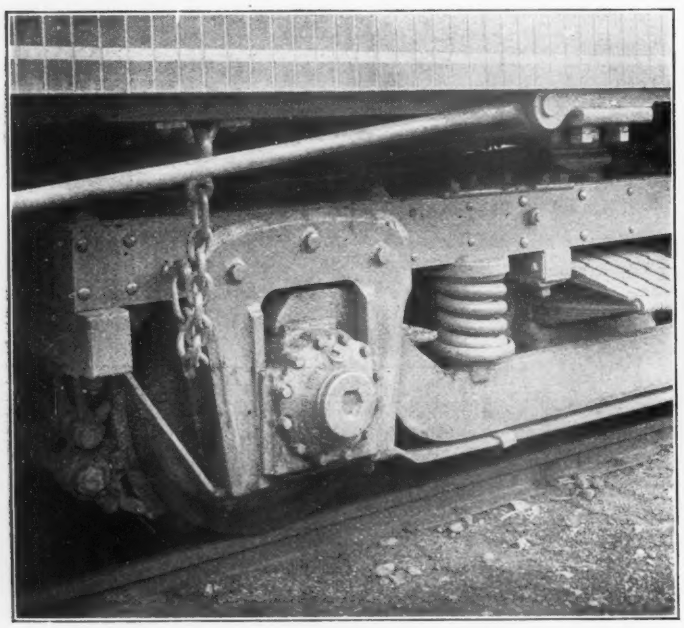
This rather extensive experience with heavy electric cars has developed no feature of disadvantage which would seem to prevent their use on heavier steam railroad equipment. In addition to the original car on the Bangor & Aroostook, two more of the same class have recently been fitted with roller bearings, but these three were, up to a recent date, the only steam railroad



Roller Bearing Journal Box

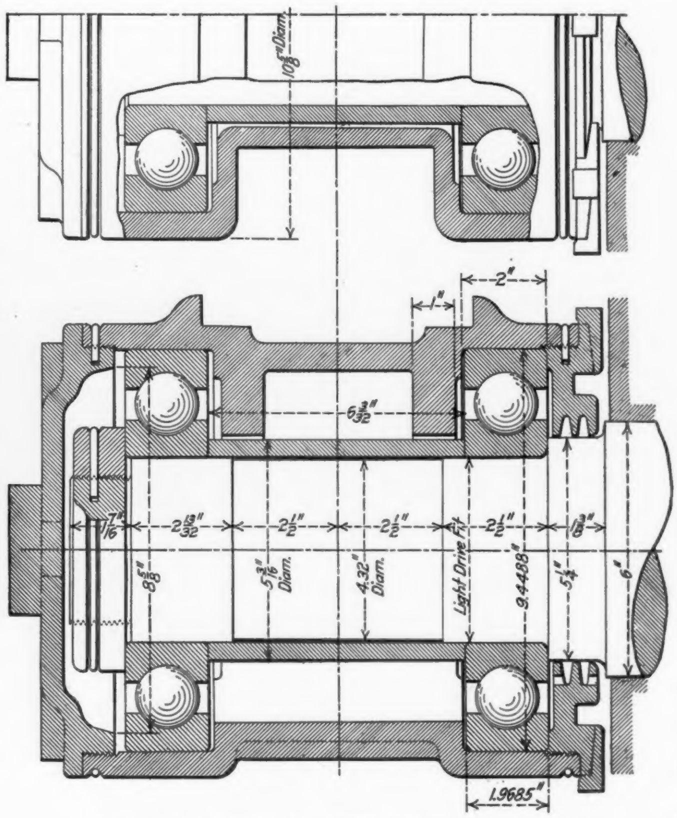
cars that have been so equipped. During the past few months, a very heavy all-steel passenger car has been fitted with roller bearings, and another similar car with ball bearings. The experience with these cars will go a long way to determine the future application of these bearings.

A test was recently made between two trains on the Bangor & Aroostook, each consisting of a locomotive, a baggage car and



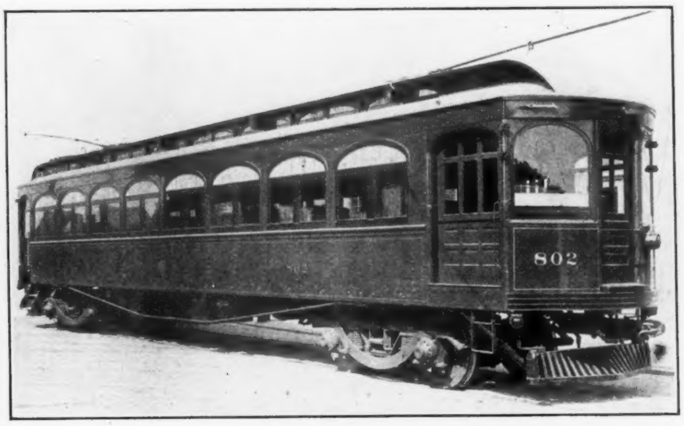
Appearance of a Truck Fitted with Roller Bearings

two coaches. The locomotive and baggage car were the same in both cases but in the first train the two coaches had plain bearings, and in the second train they were the cars equipped with roller bearings. The crew was the same on both trains. The run covered a distance of 85 miles, and a round trip was made with the results shown on the accompanying curves. Stops were made at each station in both directions. It will be seen that the basis of the test was the amount of coal consumed



Typical Arrangement of Ball Bearing Car Journal

by the locomotive. On the up-trip which was almost continuously up grade, the train with plain bearings required about 4,900 lbs. of coal, while the one with roller bearings used but slightly over 3,200 lbs., a saving of 1,700 lbs., or nearly 35 per cent. On the return trip, which was mostly down hill, the first train consumed somewhat over 2,700 lbs. of coal, and the second 1,950 lbs., a

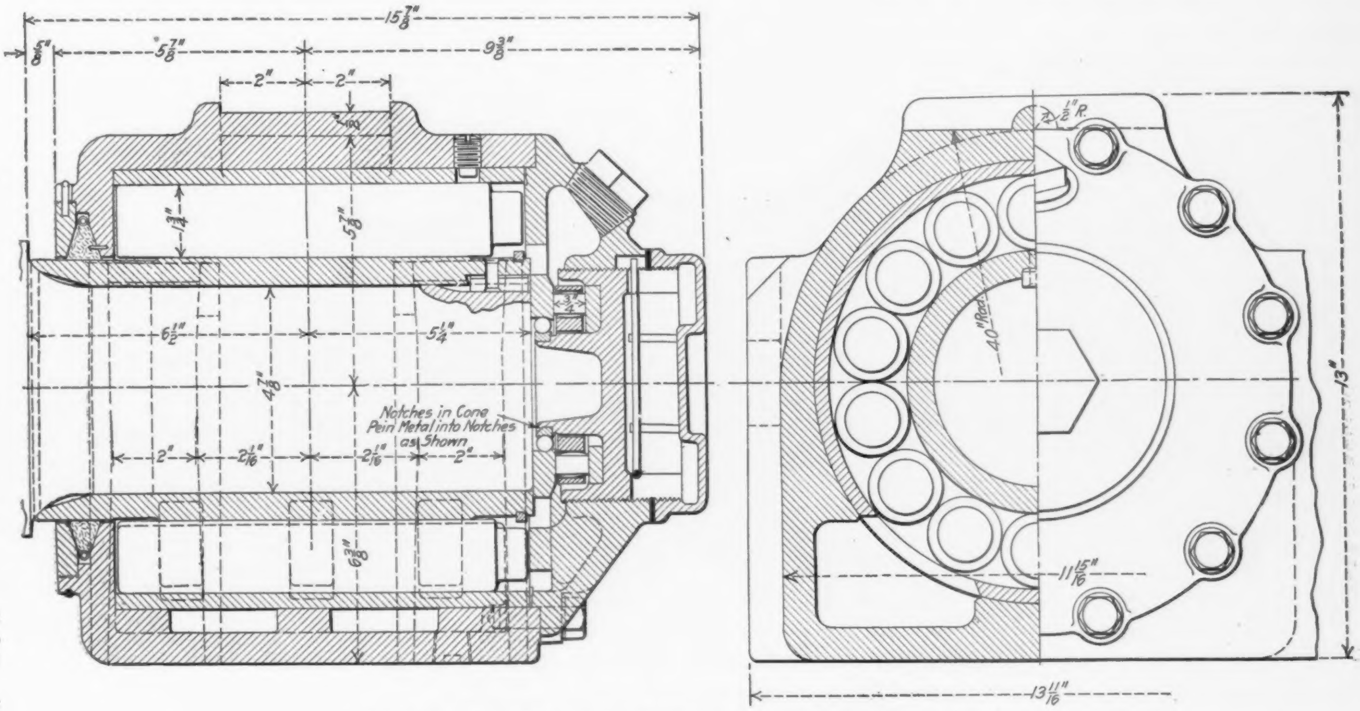


Heavy Interurban Car with Roller Bearings

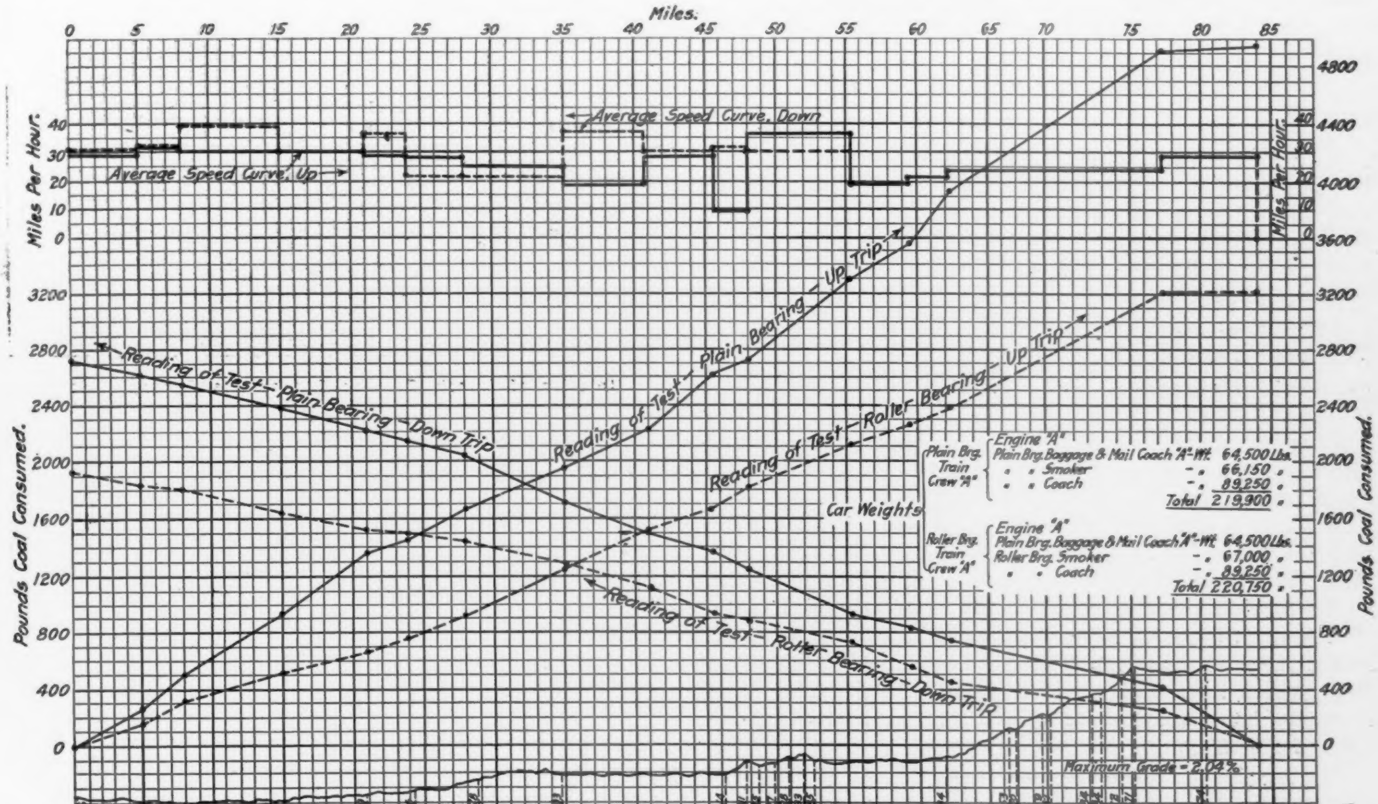
saving of 750 lbs., or about 28 per cent. of the fuel. An inspection of the curves shows that the greatest saving was made during the acceleration and on the heavy grades combined with sharp curves. On the level the saving of coal was very small and, in fact, for certain short distances the roller bearing train seemed to consume more fuel. This is explained by the method of obtaining the amount of coal burned. The shovelfulls put on the fire between stations were counted and on some of the short sections one shovelfull more or less was a considerable per-

centage of the whole. On the down hill run the reduction in coal consumption seemed to be almost continuous during the trip. In addition to the saving of fuel, experience has shown that these bearings require but about one-half pint of lubricant for nearly 5,000 miles of service. Of course no hot boxes have developed and inspection indicates that the bearings are in perfect condition.

An interesting test was made some time ago to show the decreased drawbar required to start a car with roller bearings. Car No. 87 on the Bangor & Aroostook which was the first one



Form of Roller Bearing Used on the Bangor & Aroostook Coach



Comparative Test of Roller and Plain Bearings on the Bangor & Aroostook

to be fitted, was made up in a train with a car of the same type and weight fitted with plain bearings. The two cars were run a few miles to limber them up and the roller bearing car was then set on a piece of straight level track and the rails spotted beneath the wheels. It was found that one man could move this car in either direction. The other car was then set on the same spot mark and nine men could not move it in either direction.

A section of the bearing used on this car is shown in one of the illustrations. This section is typical of the construction used under the heavier class of cars. It consists essentially of a sleeve which fits over the journal, a casing which fits in the housing or box proper, rolls, rolling between the sleeve and the casing and a plain roller thrust bearing carried by a thrust nut, readily adjustable in the front cover. The outer collar of the M. C. B. journal is turned off and the size of the axle is slightly reduced to allow the inner sleeve to be slipped over it from the end. The sleeve, casing and rolls are made from alloy steel and are heat treated, tempered and accurately ground to a uniform diameter. It has been found that accuracy of workmanship in this connection and the quality of material are of vital importance to the success of the bearings. The inner sleeve has a snug fit on the axle and is held in place by a key. The sleeve is prevented from moving endwise by a self-contained ring on the end of the axle. There are 14 1¾ in. diameter rollers held in a cage. The casing has an accurate fit and a bearing in the box proper for its full length and circumference. The location of the openings at the bottom for the admission of the lubricant will be seen in the cross section. The roller bearing for taking the end thrust consists of two washers or tread rings and a cage in which the rollers are contained. This bearing is made to form part of the thrust nut and is removable with it, thus making the inspection of the journal a very simple operation. As there is no part of the thrust arrangement that is subject to wear the desired amount of lateral movement between the axles and the journals can always be maintained at the most economical point. To prevent leakage of the lubricant through the rear of the box, an automatic gland is used which consists of an ordinary V shaped gland carrying a felt packing. On top and around this packing is a small coil spring with the ends joined. The tension of the spring pulls it back firmly against the axle and compensates for any wear. The sleeve is carried through the rear cover of the box to prevent the spring from forcing the packing out of place when the box is removed from the axle. To prevent leakage through the adjusting nut in the front cover the threads are made long and, as a further guard, a cap is used.

This box is slightly wider than the standard M. C. B. journal box for the same size axle and requires a different pedestal with more room between the jaws. In other respects, however, it requires no alteration of the truck or its parts. Its appearance is shown in the photograph.

It has been found that roller bearings in steam railroad service result in some indirect advantages. One of these is that the roller bearing equipment will break more rapidly and smoothly than does the standard journal. This seems to be due to the fact that when the brakes are applied on roller bearing wheels the effort is transmitted directly through the rolls to the truck frame without lost motion. When the brakes are applied with a plain bearing, however, there is a tendency for the braking effort to crowd or roll the axle out of the journal, resulting in a longer piston travel and less effect from the brake shoe. This eventually has a considerable effect on the amount of air required for braking.

State Railway Mileage in Queensland.—The total length of railways included in the Queensland state system on June 30, 1912, was 4,266 miles, inclusive of the Etheridge Railway (143 miles), which was built by a private company but is operated by the state railway department. The lines are 3 ft. 6 in. gage.

LUNCH COUNTER CAR

The Pennsylvania Railroad has placed in service between New York and Philadelphia, on trains which also carry ordinary dining cars, an all-steel lunch counter car. It is intended to continue the experiment for a sufficient length of time to determine just which is more popular with the traveling public. The object in building the car was to see if it would permit of serving meals to passengers quicker, and thus serve more persons than is possible in a dining car.

The new car is 80 ft. long, and there is a mahogany counter extending over half the length of the car, facing which on one side are revolving mahogany chairs, secured to the floor. The counter is long enough to accommodate 21 people at one time. Back of the counter against the wall there are 20 cupboards for supplies, in addition to receptacles for crushed ice, drinking water, etc. Shelves for linen and silver occupy the space under the counter. Sunk in the counter at the end away from the kitchen is a cigar humidor, and at one end of the car there is a wash basin for the use of passengers.

Interior of Lunch Counter Car on the Pennsylvania

The pantry and kitchen are at one end of the counter. The pantry contains dish racks, cupboard, a sink and a locker. There is no necessity for waiters to enter the kitchen. The kitchen itself is about 11 ft. long; it contains a range, broilers, steam table, ice box, coffee urn, soup receptacle and meat warmer.

Violations of the Ash Pan Act.—During the fiscal year ending June 30, 1913, three cases involving five violations of the ash pan act were transmitted by the Interstate Commerce Commission for prosecution. Defendants confessed judgment during the year as to 10 counts; 1 count was tried in court, resulting in a verdict of defendant. Penalties to the amount of $1,200, exclusive of costs, were collected and paid into the treasury, and additional penalties in the sum of $1,000, exclusive of costs previously assessed by the courts, were on July 1, 1913, pending payment by defendants.

DISCUSSION OF STEEL BOX CARS

Papers at the Meeting of the American Society of Mechanical Engineers Arouse General Interest

At the meeting of the Railway Session of the American Society of Mechanical Engineers, December 3, George W. Rink, mechanical engineer, Central Railroad of New Jersey, presented a paper on Steel Underframe Box Cars, an extract from which was published in the Railway Age Gazette, Mechanical Edition, December, 1913, page 657. R. W. Burnett, general master car builder of the Canadian Pacific, presented a paper on Steel Frame Box Cars, which was abstracted in the Railway Age Gazette, Mechanical Edition, December, 1913, page 651. This paper was read by H. H. Vaughan, assistant to vice-president, Canadian Pacific. The papers were discussed by H. H. Vaughan, Canadian Pacific; B. D. Lockwood, chief engineer, Pressed Steel Car Company; W. F. Kiesel, Jr., assistant mechanical engineer, Pennsylvania Railroad; O. C. Cromwell, mechanical engineer, Baltimore & Ohio; E. G. Chenoweth, mechanical engineer, Rock Island Lines; W. S. Atwood, chief engineer, Canadian Car & Foundry Company, and C. A. Seley, American Flexible Bolt Company. Extracts from some of the discussions are given below:

STRESSES IN THE DIFFERENT MEMBERS

W. F. Kiesel, Jr.—The two papers on box cars form an interesting study, and will no doubt lead to a closer investigation of stresses in car structure, which in turn will tend to keep cars off the repair tracks for longer periods of time. It is also to be hoped that the recommendations for more uniformity in design will be given serious consideration, and that this may lead to a uniform design for all roads.

The tabulations given by Mr. Rink are especially valuable and present ready means for analysis and comparison of the different types of cars enumerated. It is, of course, realized that other conditions of strength must be investigated, and a paper embodying such calculations would be entirely too long. The assumptions made and the general scheme of calculation adopted by Mr. Rink are fair, and permit estimating the relative value of each car at a glance.

There is one feature in the calculations for end strength which has not been given especial attention, and that is the ratio of stress to strain under end shock. The important point to consider is at the bolster. This ratio in the fourteen cars enumerated varies between .033 and .118. The high figures are due to the great distance between the center line of the draw bar and the neutral axis of the sills. The area of the center sills at the bolster varies from 19.08 to 36.18 sq. in., and the average is 24.75 sq. in. Without using any additional metal in the center sills the ratio of stress to strain can readily be reduced in many of these cars to the advantage of the strength of the car.

Both Messrs. Burnett and Rink seem to favor the Z-bar posts and braces because they are made of rolled material, and, as stated by them, can be readily obtained. This does not seem to be a good argument, as it is well known that standard sections of rolled material cannot always be obtained on short notices; in fact, within the past year the steel mills have quite frequently reported that certain angles, I beams, etc., could not be furnished in less than three or six months, as there was no stock on hand and they did not expect to put in the rolls for that length of time.

The railroad members of the association should record their preference in regard to the various points brought out in these papers, as this will materially help designers in determining what is best to do.

The following questions seem to be of importance:

First: Is the box car with steel side frames all that it should be? It has been argued that the shrinkage of the lining, driving of nails in the lining to secure blocking, breakage of the tongues and grooves, etc., will cause leakage, necessitating constant repairs, and that the car equipped with steel sheathing and wood lining is closer to the ideal in box car construction.

Second: In box cars with outside framing, shall all posts and braces be made of rolled steel, or all pressed steel? Advocates of pressed steel assert that pressed posts and braces are lighter per unit of strength, because they can be formed to the required shape; that they can be formed with sufficient surface at the ends for the number of rivets required to develop their full strength, while Z-bars and other rolled forms require gusset plates for this purpose; that they are not likely to be damaged by pushpoles, and, if damaged in wrecks, can be readily straightened and restored to approximate shape; that when absolutely necessary to replace them they can readily be obtained from the car owner or builder and it will not be necessary to wait for any special rolling of material.

Third: Should not the posts and braces be considered strictly as beams supported at top and bottom, in combination with straight tension and compression, as members of the side truss? Mr. Rink indicates that flattening of pressed posts and braces, where they connect with the side sills, has a weakening effect, which further indicates that he considers them as cantilevers held in vertical position by the side sills and frame braces connected thereto. In wooden cars the posts and braces were strictly beams, and not cantilevers, as they rested on top of the side sills, either directly or on castings with shallow pockets. Side sills of box cars have too little resistance against torsion to hold the posts and braces vertical; they, therefore, must depend on the strength of the side plate and the tying effect of the carlines. If, in addition to this, a solidly riveted roof is used, the tops of the posts and braces are securely held in proper alinement and the stability of the side truss is assured.

Fourth: Is it not imperative to use diagonal braces in the end framing? No argument need be presented here for this, as Mr. Rink has already furnished sufficient argument, and we know of nothing to show the contrary.

It should be noted that all of the fourteen cars enumerated have so-called box-girder center sills, and that the majority of them have a minimum section of about 24 sq. in. With this section area, a ratio of stress to strain of 0.6 can be obtained, provided proper adjustment is made for relative location of the neutral axis of the center sills and the center line of the draft gear. It would, therefore, seem that the present designs of box cars corroborate the recommendations of the Committee on Car Construction of the Master Car Builders' Association and that those recommendations are reasonable and conservative. A thorough knowledge of cars by the motive power officers of railroad companies will, we hope, lead them to ultimately endorse the M. C. B. recommendations.

IRON BOX CARS ON B. & O.

O. C. Cromwell.—The side posts and end posts, side braces and end braces, corner posts and door posts, should be brought down to a standard.

The points brought out in Mr. Rink's paper, with reference to the height of the floor above the rail, is an important one, and it appears to me that there is no good reason why we should have a variation of 6¾ in. in this height. This largely effects the height of the truck, and as it is desired to work

towards standard and interchangeable truck parts, the height of the truck is an important one to bear in mind.

In 1862 the Baltimore & Ohio Railroad built some iron box cars. These cars had wooden underframes, but the body and roof were made of iron plates. The body was about 24 ft. long, 8 ft. 2 in. wide, and about 6 ft. 6 in. high. The side and end plates were 3/16 in. sheets, applied vertically, the sheets being about 37 in. wide. The roof sheets were 32 in. wide. All sheets were riveted together at the joints. The sides were slightly convex to give them stiffness, as was also the roof. The end plates were applied perfectly straight. The sides, ends and roof were stiffened with 2 in. x 2 in. ribs, of ash.

The cars proved unsatisfactory, because in the summer time they became so excessively heated that they spoiled the merchandise, and in sudden changes of weather, produced the sweating, with damage to lading, and the cars had to be finally withdrawn from service, and used for special trade, and were ultimately converted into workmen's storage sheds, tool houses, etc.

LOCAL CONDITIONS AFFECT CAR DESIGN

E. G. Chenoweth.—There will perhaps come a time when the railroads have a standard design of a 30, 40 and 50-ton box car, but this in my opinion is yet far off. The general inside dimensions of a house car may be changed in the near future and again approved by the American Railway Association, which to some railroads only signifies which way the wind blows, as we must confess that the present standard is not by any means universally followed in purchasing new equipment. The great number of special cars which the railroads feel obliged to maintain for the shipment of special commodities, naturally has a tendency against the adoption of a standard box car. These special commodities are sure to change from year to year, and when the railroads meet the desires of the manufacturers, it generally means a car having some special dimensions, or perhaps different capacity from the standard car.

Before we get a standard box car, it appeals to me that three very important items entering into the problem must be solved in common with all railroads, viz.: capacity, dimensions and design.

We must consider that the railroad companies are far from agreeing on either one of the items as can be seen by reading the papers submitted at this meeting as well as checking cars in a large freight terminal.

The design of car is influenced by many local conditions as well as often a great many local instructions. It is regretted that the merits of a design of a car is too often inversely proportioned to the final weight of car. I believe that we are now about to the minimum limit relative to weight of box cars and the tendency is to increase, and not worry so much about the extra dead weight hauled, but more consideration given to keep car in revenue service more days of its life instead of standing on repair tracks.

The design of equipment is not for tomorrow or next year, but every part should do its part in prolonging the life of the car. In designing we too often leave the stress too close to the maximum allowance. This of course, to decrease weight, not perhaps making proper allowance for severe treatment or conditions which will cause distortion or rupture after in service for years. The deterioration of steel members is also an item which should be well considered.

In all designs of steel underframes consisting of two center members, I am convinced from experience, that a cover plate should be applied and that any diagonal bracing to side sill will not meet the requirements in severe service.

In the design of the steel frame box car, I am convinced that standard structural shapes with web plates need only to be used to get a first class car, and all will agree, I think, that in maintenance, the structural steel car will cost less.

In the design of steel superstructure cars, I am of the opinion that the underframe carrying members should be the center-sills and that the side sills only be of a proper section to complete the trussed panels. This will allow the superstructure more flexibility to adjust itself to irregularities of track and will not have the tendency to derail. A car held rigid so that the plane of the sides are always parallel will not properly take a curve. Where single sheathing is used the 1½ in. thickness seems to meet the requirements, and I think it should be tongue and groove instead of shiplapped. Some are using 1¾ in., or even thicker for end sheathing, but I would rather see the 1½ in. thickness used on both sides and ends and the extra reinforcement on ends furnished by proper design and locating end posts.

Of all the things which should be made standard, a box car side door is one of the most important, and should be the easiest standard to obtain and maintain. Yet few railroads have cars of different series which have doors interchangeable.

There are many designers of steel carlines, and while some answer the purpose for which they are designed, others are a joke. The tendency is to figure a carline for strength at the center, forgetting all about section near side plate. One function of the carline is to keep the side plates from going out as well as coming in, and therefore, it should not be designed to support the roof only.

I am of the opinion, that if need be, we should sacrifice head room to get carlines nearly straight on the bottom edge which will act as a tie rod in tension and be in best of shape to withstand compression.

The draft gear and application of same to car is the most important detail of any car, and this fact is appreciated by all railroad men; yet, what great diversity of opinion among them as to what is best. Many are holding to a spring gear, while others, claim that the friction gear is best. Does the good obtained from the use of friction gear warrant the extra expense?

We should have a minimum allowable area for draft sills and this should be effective area as well balanced about the line of draft. I have often wished that the standard draw bar height was increased at least 1 in., which would allow a better application of the high capacity draft gears.

VENTILATED ALL-STEEL CARS

C. A. Seley.—About fifteen years ago three factors influenced some progressive railroads to the larger introduction of steel in frame work of freight cars; increased capacities, greater structural strength to withstand operating stresses, and the approaching equalization of costs of steel and car lumber, particularly for framing.

For new cars, I believe there is now no good argument as against steel for the complete framing, so combined that the sides will assist in carrying the load. The question then arises as to how far to go with the use of steel for such parts of the car as merely contain or shelter the load. Manifestly, floors must continue to be made of wood to enable blocking of the lading. Aside from this, there are many predictions of all steel box cars. In my opinion, this will be the ultimate construction, but doubtless slow in general adoption account of the still favorable balance in favor of the cost of wood for lining and sheathing, and in combination with steel plate for roofing—whether of the so-called outside or inside type.

When the all-steel box car does come, it will have to be arranged with ventilation features to prevent damage to lading from sweating and from accumulation of excessive heat which may unfavorably affect many high grade commodities if shut up in a steel box without such ventilation.

Both writers have discussed the advisability of the "standard" car. I doubt very much if this idea will ever be consummated, even to the extent of the standard material idea advanced by Mr. Burnett. The difficulty in the way is the human element.

If we all thought alike we would all wear blue suits and red ties. The M. C. B. Association has standardized the parts essential to interchange, and under this head may be listed couplers, air hose, wheels, axles, journal boxes and contained parts, brake shoes and brake gear parts. The government has standardized safety appliances.

This all sounds fine, and to the uninitiated would seem to settle most of the difficulties in car repairs, but we all know that very few of the M. C. B. standards are really standard in exact detail, and the Interstate Commerce Commission safety appliances necessarily give considerable range of dimensions and applications within which their requirements may be fulfilled.

It is difficult for one not in railroad service to appreciate the whole problem, and particularly the influence of interchange requirements. A railroad may be of low gradient, equipped with light power, and have a class of traffic that would ordinarily keep their cars on their own line, and the cars which would most economically fulfill all requirements for such a line and service can be readily imagined. In interchange, however, these cars might be required to go anywhere from coast to coast, in all kinds of tonnage trains, through hump yard trials and other tribulations never experienced on the parent road.

A railroad car designer can never afford to worship standards in view of the rapid evolution in transportation.

STANDARD CAR IMPROBABLE

H. H. Vaughan.—I do not believe that we are ever going to adopt one standard type of car or one standard design of car and build it indefinitely. There are sure to be improvements and alterations that the different roads think it desirable to make, and if we had a standard car tomorrow the next order that was let would have a few changes from it, and if we use standard material and material that can be obtained without difficulty, and keep to certain standards on the parts that both Mr. Rink and Mr. Burnett have mentioned, I think that we are going as far as we can go in the direction of a standard car.

I quite agree that the draft castings, arch bars, bolsters and some of the other parts should be standardized to a greater extent than at present. It does seem absurd that the slight variations made in these parts should necessitate their being obtained from the car owners, when repairs are to be made on foreign lines, and that serious delays should ensue on account of these parts not being available.

Some of the features of the underframe design of the C. P. R. car were not altogether a question of engineering, but were largely governed by a feeling I had that if you make a thing plenty strong enough you never lighten it, and that if you will get a new design a little fine and then strengthen it, in the weak points, you will finish up with a considerably lighter design than if you started out with some arbitrary figures and made everything plenty strong enough to start with.

In designing a car you have got to figure the service the car is generally going to run in, not the service it may run in. We figured that 60 per cent. to 75 per cent. of the service to which the box cars are put, both in Canada and in the United States, is service in which this type of underframe will stand up perfectly satisfactorily. I feel that that assumption is justified by the results we have had with this type of car. If there was any decided weakness in this type we certainly have found it out in five years.

The fact that we have had 14 or 15 cars destroyed on foreign lines indicates that, while the construction may not be as strong as would be desirable for some service, it is strong enough for the average service in which the cars are used. I do not believe today that it is a good commercial proposition to put weight on to a car for occasional service. We have never, as far as I know, had a single car that has shown vertical weakness in the center sills. The omission of that cover plate has introduced a certain amount of longitudinal weakness through the center, as well as buckling sidewise, but in no case buckling vertically. We expected that the floor would be sufficiently stiff to prevent any lateral buckling of the center sill, and we have had some floors that were so loose that I do not think they have acted that way, if the car has been permitted to buckle. The center sills and the side sills have ample strength to hold up the corners of the cars under general conditions, and the carving of 500 lb. weight there, and 500 lb. in the cover plate, and a few hundred pounds here, and a few hundred pounds there, is what has made that car the light car that it is as regards its weight. We have a car weighing 36,500 lbs. and carrying 40 tons, and which can be loaded to 93,000 lb., before exceeding the permissible loading on the axle.

I want to call attention to one point of view, and that is the advantage of reduced weight on net earnings, and not on the cost per ton mile. Taking the figures for the Canadian Pacific in 1913. We carry 22.34 tons per loaded car mile, and our percentage of light car mileage was 28.5 per cent. of the loaded car mileage. That gives an average load of 16.8 tons per car mile total. The average weight of light car is about 18 tons, giving an average weight of loaded car of 34.8 tons. Supposing that the car weighed one ton more. Then there would be an increase of the ton mileage of 2.85 per cent, or if you were formally operating on a ratio of 70 per cent, under this changed condition of weight, you would be operating on a ratio of 72 per cent. The net tons would go down from 30 per cent to 28 per cent, which is a difference of 6 per cent; in other words, while you have only changed 2 per cent in your cost of transportation, you have changed about 6 per cent in your net earnings, and net earnings are what we are after.

I think the question of weight is something which must be looked after carefully in car design; we must not design cars that are cheap to keep up altogether, and cars which will not need repairs, but try to design a car that is most economical for the railroad company to handle its traffic. It may cost $5.00 or $10 a car more a year to keep up, but it will save two or three times that in the weight you are hauling about uselessly.

In reference to vertical or horizontal sheathing, I agree with Mr. Rink. Mr. Burnett stated that there were a number of cars which were quite open. We have had a lot of cars which have shrunk to an extent to cause us a great deal of anxiety, but we have had singularly few cases of damage claims on account of it. These planks are all ship-lapped, and even when looking at a car you would think you could see through the openings. It is rare, however, for us to get any complaint. As Mr. Burnett says, it is not difficult to tighten them, and the only reason we have not tightened them is because we have not had sufficient complaints to justify our taking the cars out of service and doing the work. The vertical sheathing would be, possibly, a preferable arrangement if you could accompany it with an economical and convenient design of side framing. This is a difficult thing to do—the truss form of side framing naturally lends itself to horizontal sheathing. If you go to vertical sheathing, you will have to introduce horizontal members to take care of the fastenings. The distance from the top plate to the sill is too great to permit side sheathing to get any support if placed vertically.

I would be very glad, while we are here, to hear any discussion from the members present on the roof question. The fight seems to be one between the three different types of roof which Mr. Rink describes. The road I am with has been an advocate of the inside metal roof so long, that while we are experimenting with the all metal roof, we are rather wondering why we are doing it. I know that quite a number of our members here have used extensively the all metal roof, and we would be very much interested to know what results are obtained from that style of roof in comparison with the older type.

RAILWAY CONSTRUCTION IN ITALIAN TRIPOLI.—Nearly 60 km. of railways are said to have been built in Tripoli since the war of the Italians against the Turks.

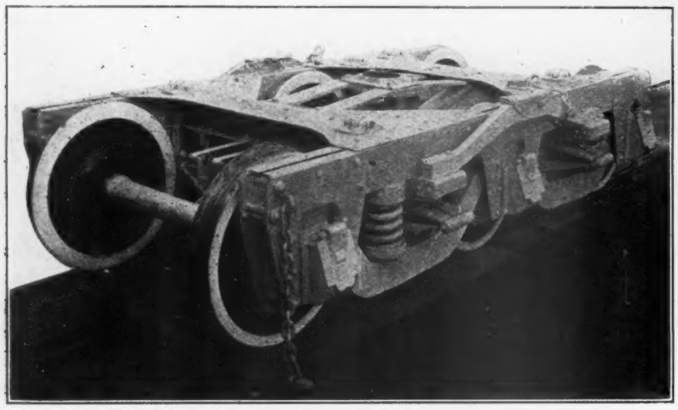
STEEL TRUCKS FOR PASSENGER SERVICE

The Canadian Pacific has in use a type of four and six-wheel steel truck for passenger train cars that was designed by the general master car builder, R. W. Burnett, and which has proven to be very efficient. The general appearance of the two trucks is clearly shown by the illustrations from photographs,

Four-Wheel All-Steel Passenger Truck

while the details of the construction of the six wheel truck is illustrated by the line engraving.

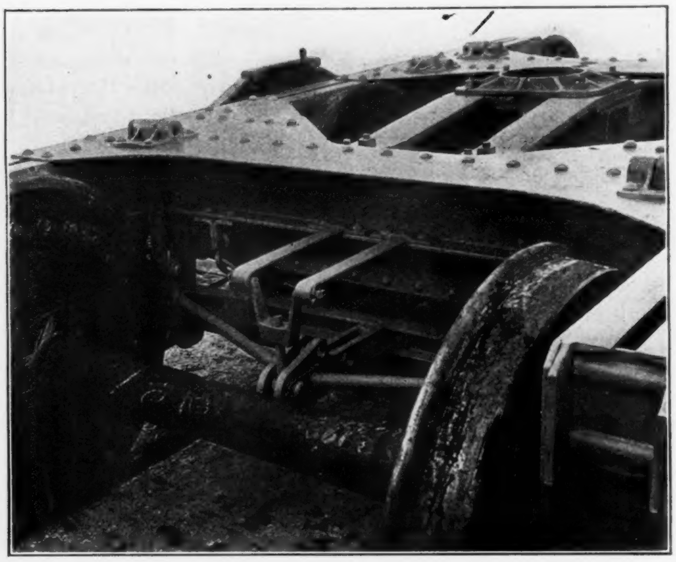
There are a number of points about the truck that at once attract attention. First is the smooth straight line external ap-



Six-Wheel All-Steel Passenger Truck

pearance with the omission of the usual end pieces. The absence of the end pieces gives a better clearance for the car steps and allows a better opportunity not only to strengthen the draft rigging but to inspect and maintain it. On the end toward the center of the car there is a better opportunity to install the axle light apparatus.

The side beams are formed of two 8 in. channels, with their flanges toward each other. They are riveted together with spacing blocks between so that they present a smooth surface on the outside. The two beams thus formed are tied together by Z bar transoms and straight gusset plates extending all of the way across the truck at both the top and bottom of the channels. At the pedestals the lower flanges of the channels are cut away to admit the equalizers and are, at the same time, stiffened by the pedestal plates. These are made of flat plates which are first punched approximately to shape, and then milled to the exact size. In designing the truck, it was expected that these pedes-

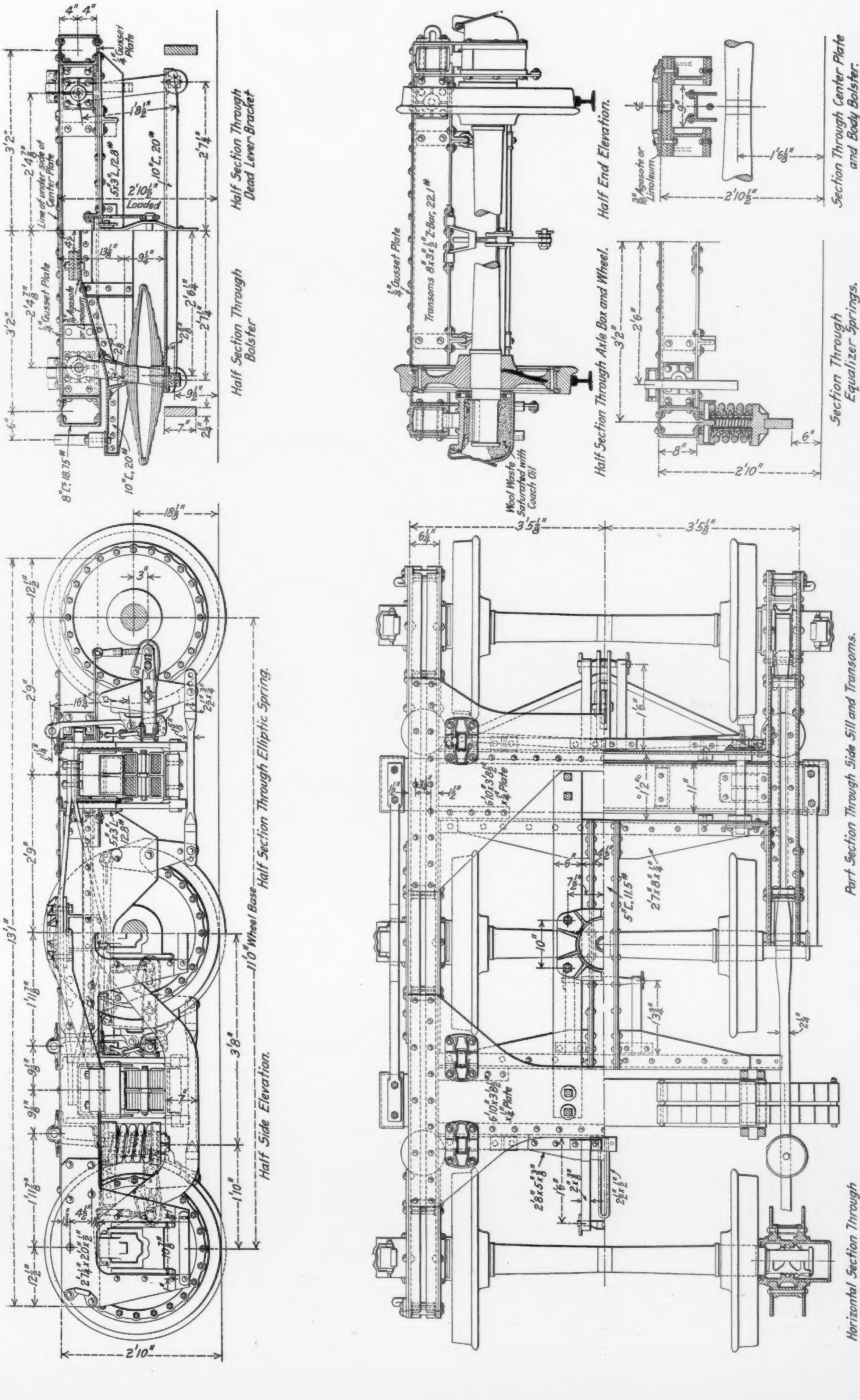


End View Showing the Brake Beam Adjuster and the Absence of the End Piece

tals would bend in case of a derailment, but that they could easily be bent back again into shape. Experience, however, has shown that whenever a derailment has occurred the pedestals have not been distorted and it has been possible to carry the car body to the shops on its own trucks.

For wearing strips, chilled cast iron liners are riveted to the jaws, and these have shown wearing qualities superior to anything else that has been tried. Neither liner nor box has yet shown any appreciable wear and the indications are that both will run indefinitely. At the bottom, the jaws are tied together by a short pedestal tie bar held in place by a pin, fitted with cotters and without bolts or nuts. To remove a pair of wheels,

Another View of the Canadian Pacific All-Steel Six-Wheel Truck for Passenger Equipment



General Arrangement of the Canadian Pacific All-Steel Six-Wheel Truck for Passenger Service

all that is required is to take out two cotters for each pair of wheels, pull out the pins and lift the frame.

The absence of the end pieces necessitated the use of inside hung brake beams, and these are installed without any retracting springs, but with a special brake beam adjuster. This is very clearly shown in the enlarged end view of the six-wheel truck. It consists of a hanger carried by arms riveted to the transom. Into the bottom of this hanger is screwed the carrier that supports the truss of the brake beam. No check nut or cotter is required to hold it in place, as it cannot turn and the adjustment is effected by removing the pin from the brake beam, screwing the carrier to the proper position and replacing it in the beam.

Bolts and nuts are avoided and one of the arrangements for doing this is to be found in the bracket for the spring plank hangers. It will be seen that these are on top of the gusset plates. They are simple castings with a seat for the hanger pin. This pin is held in place by a wall over the hole at one end and a cotter pin put across the hole at the other end. To remove the pin, a hole is left in the wall, through which a drift can be pushed or driven.

In spite of the substantial appearance and actual strength of these trucks they are lighter than the composite truck which they replace.

INTERSTATE COMMERCE COMMISSION AND STEEL CARS

In its last annual report the commission noted that the railroads were making progress in the substitution of steel and steel underframe passenger cars for those of wooden construction. The superiority of these modern cars over the old style wooden cars has been amply demonstrated by their performance in both collisions and derailments, and to insure that all carriers make proper efforts to procure these modern cars legislation should be enacted prohibiting the use of wooden cars in high speed through train service after a certain date. Reasonable time should be given the carriers for compliance with the provisions of any law of this kind, and its application in the first instance should be confined to important high-speed trains. There are a great number of wooden cars now in service, and the carriers should be permitted to make use of these cars on branch lines and in local service until they can be replaced by steel equipment, but the law should provide that all new cars constructed after a certain date should be made either entirely of steel or of steel underframe construction of an approved design.—*From the twenty-seventh annual report of the Interstate Commerce Commission.*

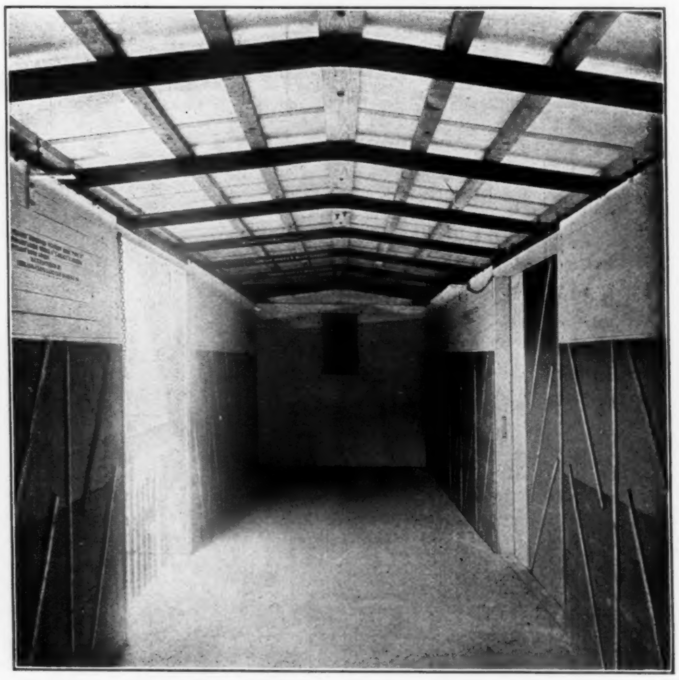
SARATOGA AND SCHENECTADY RAILROAD.—The locomotive engine commenced its regular trips on this road on Wednesday the 28th ult.; on which occasion a party of gentlemen from this village and Ballston Spa, were politely invited by John B. Lasala, Esq., one of the directors and a principal stockholder, to join in the festivities of the occasion. They repaired to Schenectady in a railroad barouche, where they were joined by two of the directors. The engine left that place a little before 12 and reached this village, drawing a train of 12 or 14 carriages and wagons, in one hour and twenty minutes. The travel is continually augmenting, and it is a source of no small pleasure, that the various estimates of income heretofore given are likely to be more than realized. Though not immediately connected with the work, we cannot but feel a deep and lively interest in its prosperity, and in everything pertaining to the welfare of its stockholders. Another engine, we understand, will be placed on the road in a short time.—(Saratoga Sentinel.) *From the American Railroad Journal, June 7, 1834.*

CONVERTIBLE BOX AND STOCK CAR

On a number of roads serving the stock growing districts there are certain times of the year when stock cars are required in large numbers, and in order to supply the demand it is usually necessary to operate many trains of empty stock cars, while at

Car Ready for Shipping Stock

the same time loaded box cars carrying general merchandise are moved in the same direction and frequently are returned empty to the originating point. For a number of years E. D. Levy, assistant general manager of the Frisco lines, has been endeavor-

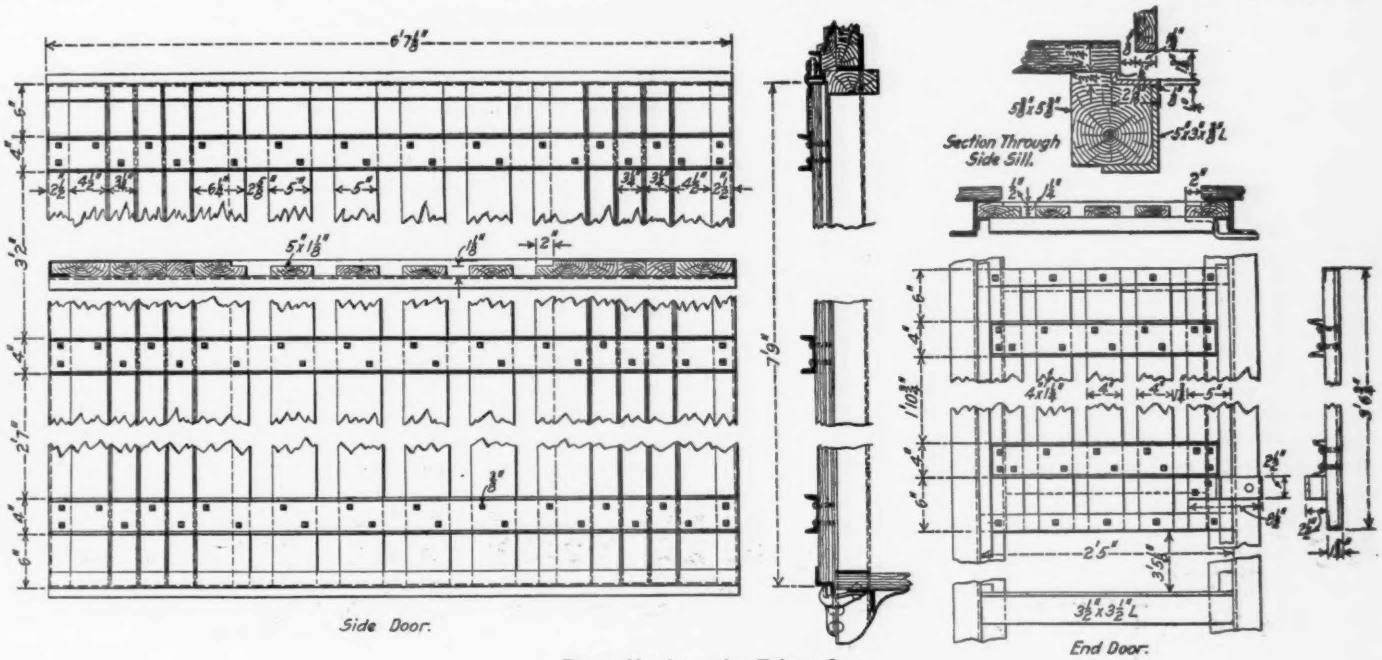


Car Ready for Shipping Merchandise

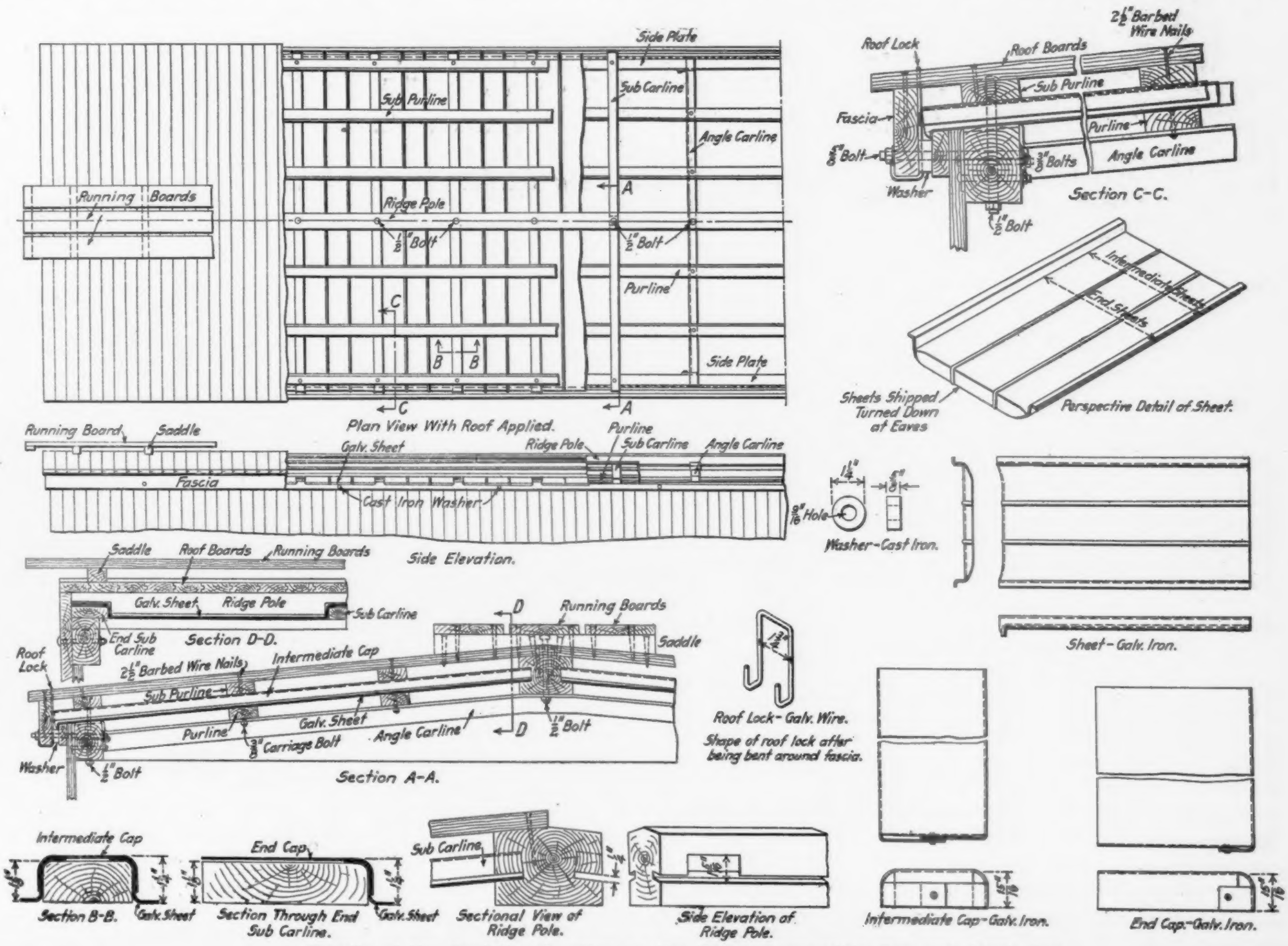
ing to decrease this cross hauling of empty cars. Attempts were made to use the stock cars for carrying general merchandise, the roof and sides being covered with tar paper for this temporary use. This, however, was unsatisfactory on account of

the construction of the cars, and only a small percentage of them could be used in this way.

In order to obtain a stock car that could be more readily converted to a box car, a new car was designed by Mr. Levy as shown in the accompanying illustration. This car is simply a box car provided with slats, and has a special design of floor that more readily permits of its conversion. With these exceptions the car is essentially identical with the new Frisco box car, described in the October, 1913, number of the Railway Age Gazette, Mechanical Edition, page 555. There is also a further difference in that the Chicago-Cleveland Car Roofing Company's type B Improved Winslow roof, with angle steel carlines and



Doors Used on the Frisco Car



Details of the Roof Construction on the Frisco Convertible Box and Stock Car

X brace, is used on this car instead of the outside metal roof.

The car is designed for a capacity of 80,000 lbs., and has the outside steel frame superstructure. The arrangement of the side framing is clearly shown in the illustration. The solid siding extends to a point about 5 ft. 3 in. from the floor. The slatting is 1½ in. thick and 5½ in. wide, and is fastened to the posts and braces by ½ in. carriage bolts. The opening between the slats is 1¾ in. The end construction is the same as that for the box cars. It will be noticed in the section through the side sill that the floor of the car is ½ in. above the bottom of the lowest slat, and an opening of ⅞ in. is made between the floor and the car siding This is to permit drainage of the car when used as a stock car, and also to allow the tar paper to be extended below the floor when converting to a box car, so as to insure positive drainage from the sides in wet weather. Two strips of tar paper are used on the inside of the car to cover all the openings between the slats, and are lapped so that the moisture cannot work through to the inside of the car. The tar paper is held in place by laths, used as cleats, nailed to the slats. The slats in the door are ½ in. thinner than the edges of the door, in order to permit the tar paper being applied without interfering with the action of the door.

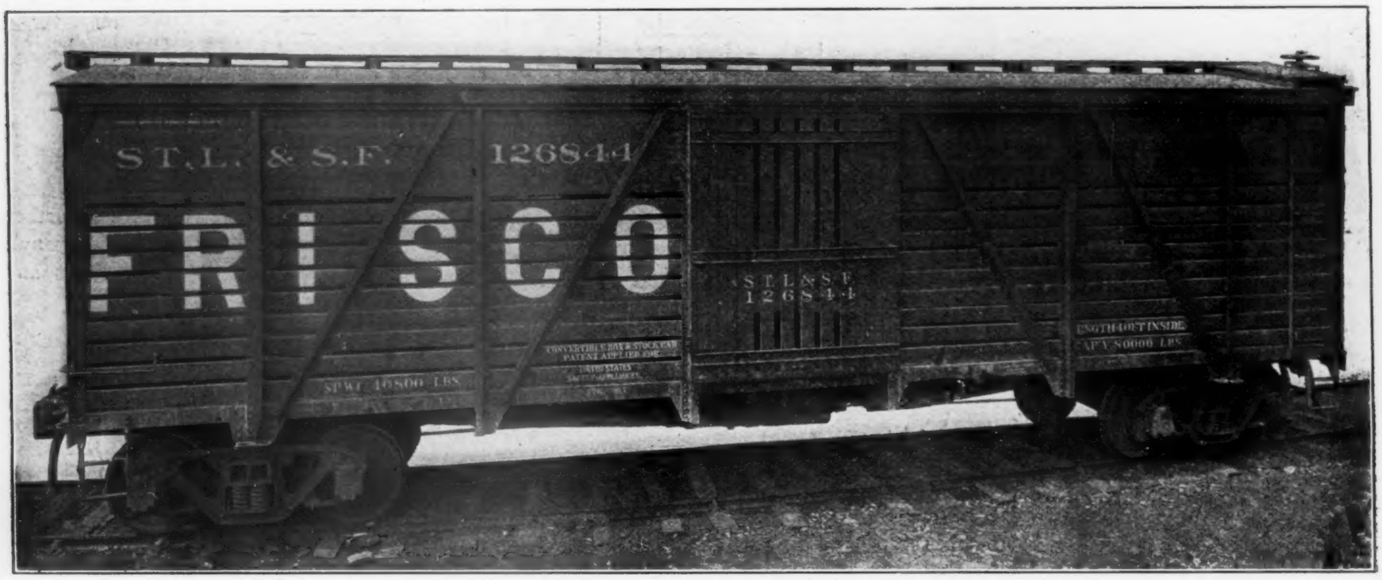
The double roofing has been found to be cooler by an average difference of about 4 deg. than the single or outside roof throughout the very hot weather, and this feature is of advantage in stock cars, especially when carrying hogs.

With a design of this kind, the total number of cars used in the stock growing territory may be materially reduced, since box cars running out of the stock market may be used to carry general merchandise and freight moving in packages, bales, boxes, barrels or other containers which are being sent into these districts. On the return trip the temporary sheathing may be removed and the cars loaded with stock. In this way it has been estimated that about 2,000 such cars would do the work of 3,000 straight box or stock cars on the Frisco Lines. It was estimated that these 2,000 convertible cars would save about $162,000 in transportation costs, due to the hauling of empty cars. To be conservative, however, the actual saving is considered only one-half of the theoretical saving, or $81,000; this provides for cases where it would not be possible to use some of the cars on the return trip. The cost of converting one of these cars is about $2.00, which it is estimated would amount to $46,000 on the 2,000 cars for one year, which would make a net operating saving of $35,000. Since these 2,000 cars would replace 3,000 straight box or stock cars there would be a saving of 1,000 cars, the saving in interest, maintenance and depreciation on which would amount to about $170,000. Therefore the total net saving would be in the neighborhood of $205,000, or $102.50 per car per year. While this car might be used both as a box and stock car, a road would not be warranted in replacing all its stock cars with this type of car, but a careful analysis of the empty cross hauling would clearly show what percentage could be used to good advantage.

These cars were built in the company's shops and the selling rights have been granted the Chicago-Cleveland Car Roofing Company, Chicago, for the convertible features, a patent for which has been applied for by Mr. Levy.

The general dimensions of the car are as follows:

Inside length	40 ft.
Length between end sills	40 ft. 11 in.
Length over running boards	42 ft. 1 in.
Length over striking castings	42 ft. ¾ in.
Center to center of bolsters	31 ft.
Width inside	8 ft.
Height from top of floor to under side of carline	8 ft.
Height from rail to top of floor	4 ft. 1¾ in.
Height from rail to eaves	12 ft. 5⅝ in.
Width of side door opening in clear	6 ft.
Height of side door opening in clear	7 ft. 6⅝ in.
Truck wheel base	5 ft. 6 in.



The Frisco Car May Be Used Either as a Box or a Stock Car

INTERNAL COMBUSTION LOCOMOTIVES.—The internal combustion locomotive as a factor in main line locomotive practice has now passed the proposal stage, and a number of interesting designs are available for consideration, though as yet practical realization is confined to a very few specific instances. According to the Railway News a design recently made public includes two internal combustion engines, each driving an axle through clutches, arranged one at the front and one at the rear end symmetrically to a vertical plane through the center of the locomotive. The axes of the engine cylinders converge upwards towards the central vertical plane, and the driver's stand and water tank are arranged in the center. The cooling water for the engines is circulated by pumps through coolers arranged one at each end of the locomotive. Each engine is clutched to its axle by a pneumatically operated clutch. The arrangement, therefore, produces a 2-10-2 design, with cooler and diagonal engine at each end and driver's cab in the center, the respective engine shafts being between the leading—or trailing axle, and the driving axle next thereto, gearing transmitting power to the five driving axles, which are actuated through the pneumatic clutches mentioned.—*The Engineer.*

SHOP PRACTICE

NOTES ON APPRENTICE INSTRUCTION

By H. E. BLACKBURN
Instructor of Apprentices, Erie Railroad, Dunmore, Pa.

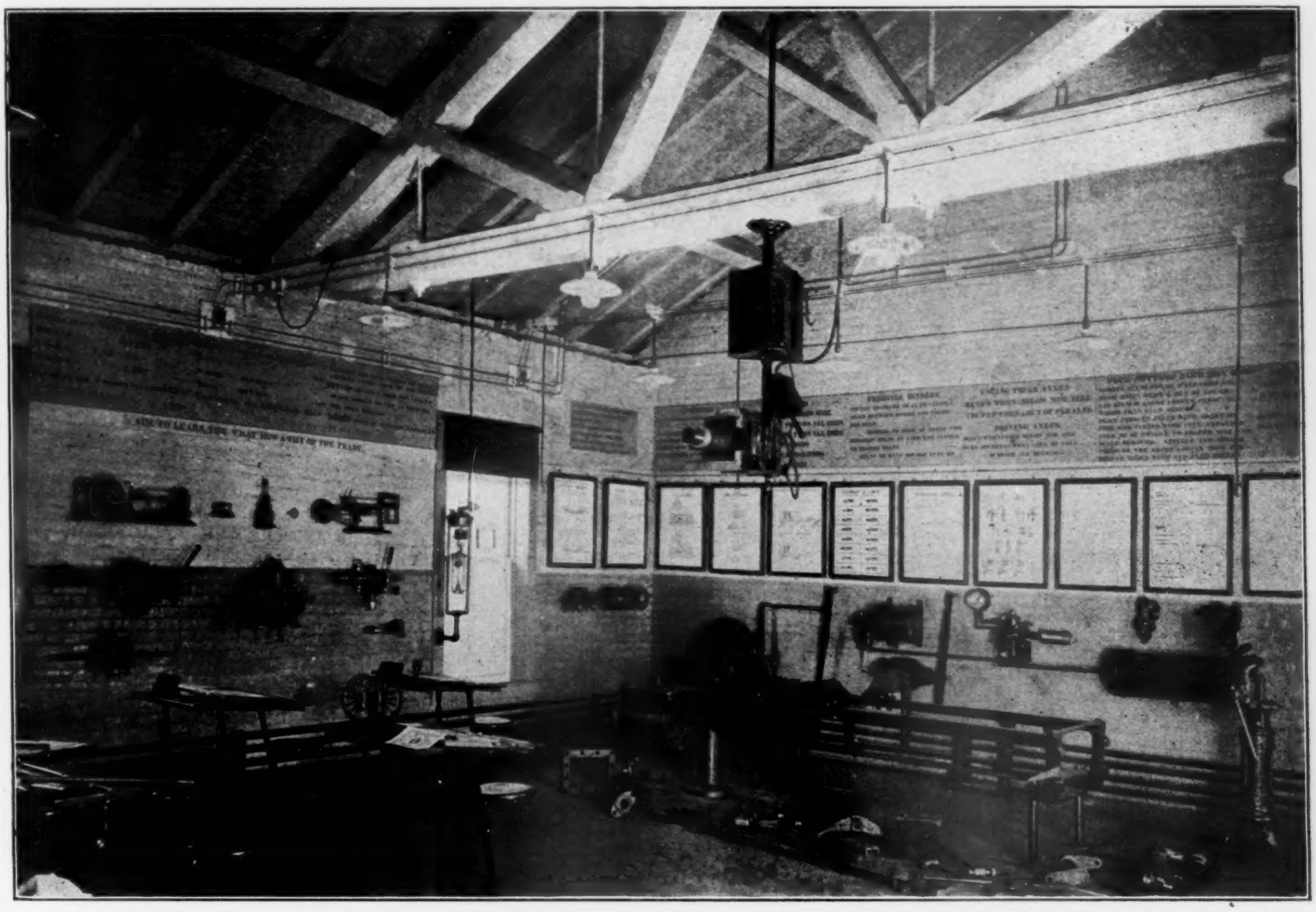
Shop education in connection with the apprenticeship system has been adopted by the majority of railroad companies. Each company has organized it according to its needs, and today some companies have systems as carefully graded as any technical school course.

Sixty years ago, when setting a slide valve on a locomotive was considered almost a trick in magic, some parent who had boys to spare would select the one he liked the least and drive him off to a magistrate, who in turn would bind the boy over to some machine shop owner. The master promised to teach the boy the trade, supply him with board and clothes for the next seven years, and for all this he was to give the boy's parents the magnificent sum of $5 a year.

Today the railroad companies are making diligent search for apprentices and they are offering as an inducement free instruction in their schools, with a three years' course in the shop and more pay in 30 days than the boy of old received in 365 days. And all this with the entire elimination of petty restrictions.

Today's greatest problem in the labor world is to find skilled help, or the material from which skilled help can be developed. Parents blame the schools for not educating their children so that they can earn a living, but for every hundred boys entering the primary grades 55 leave before they reach the last grammar grade, and only four out of the hundred graduate; in other words more than one-half of the children leave school before they receive enough education to work common fractions. Large numbers of boys flounder about trying to do something for which they are not fitted, in many cases just because the parents do not wish to have them soil their hands. False pride has made more low grade doctors and lawyers out of material that nature intended for mechanics, than any other one cause.

We should not lose sight of the fact that the bulk of the American people are wage earners and that there will be more and more of them needed. Upon the wage earners falls the task of educating their children so that they may fill these places, and what is most needed is a good grounding in plain reading, writing and arithmetic. While it is true that many children have to leave school early, it is also true that many of them wish to.



Erie Railroad Apprentice School at Dunmore, Pa.

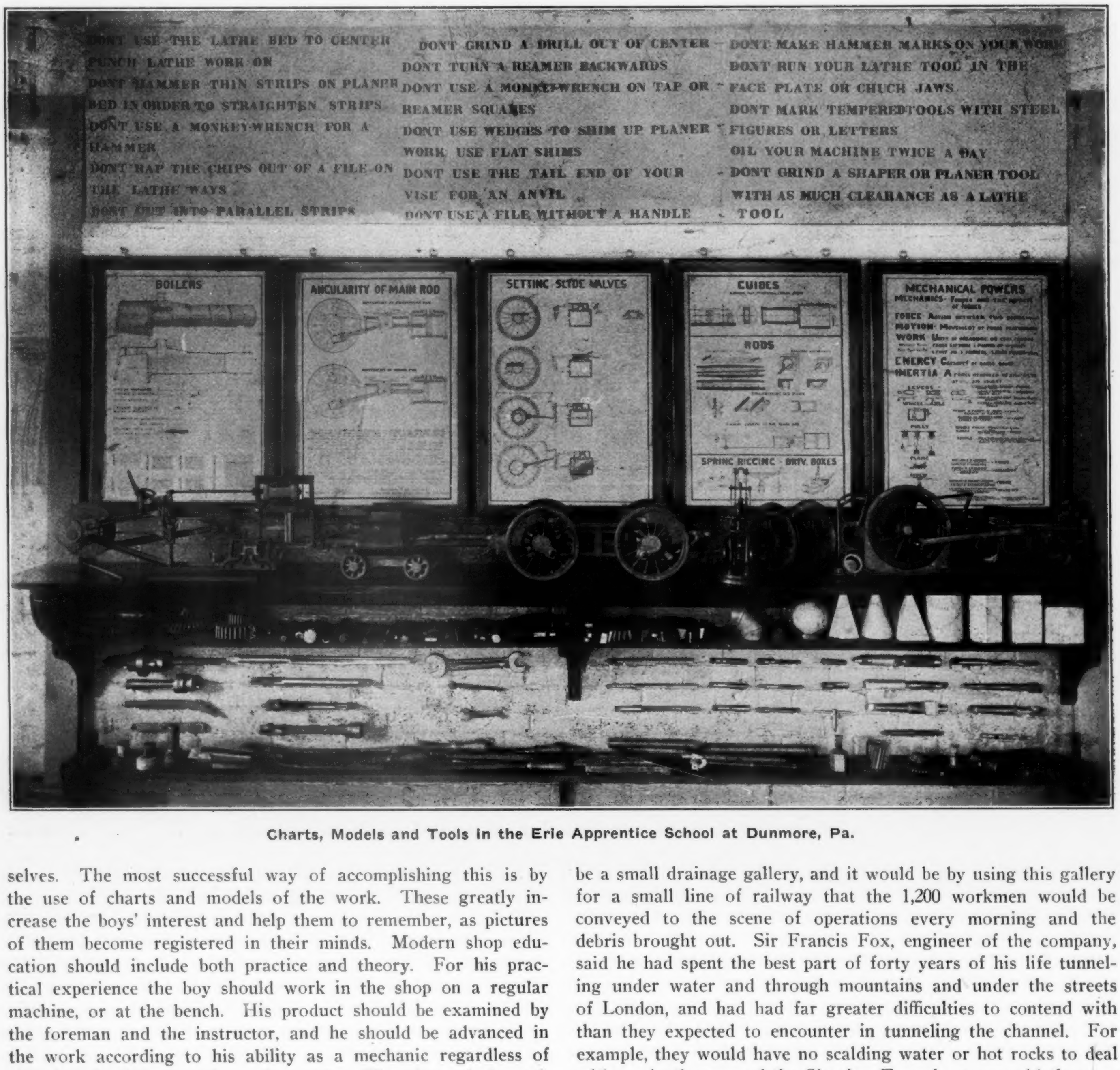
A western railroad apprentice educator asks why a railroad should be asked to educate its help when the people pay taxes to have it done at school. In general the schools do not even aim to find out what the child is capable of doing so that he may intelligently approach his life work.

A great problem in apprentice school work is to secure a man

as an instructor who understands what is actually going on in the shops and can impart this knowledge to the boys. It requires a good judge of human nature to pick out the right boy for a trade, and the use of tact to keep him on the pay roll. Nagging or unreasonable instructors never succeed with boys who are worth while.

It is poor practice to forget all about the boys during the evenings, for this is really the best time to recruit material so as to fill up the ranks of graduating apprentices. If a teacher waits and takes what comes along he will generally be disappointed. The place to find boys of the right caliber is in the night schools and Y. M. C. A. classes, or about the libraries. The teachers of the industrial art schools are always willing to unload their surplus graduates on the shop schools, and unless the instructor chooses carefully in such cases he is likely to lose his reputation as a vocational guide.

Apprentice boys must be taught to think and act for themselves. The most successful way of accomplishing this is by the use of charts and models of the work. These greatly increase the boys' interest and help them to remember, as pictures of them become registered in their minds. Modern shop education should include both practice and theory. For his practical experience the boy should work in the shop on a regular machine, or at the bench. His product should be examined by the foreman and the instructor, and he should be advanced in the work according to his ability as a mechanic regardless of the time he has served at the trade. The theoretical work should be most carefully studied and should consist principally of mechanical drawing and shop mathematics. When a boy is about to leave a machine on which he has become proficient it is good practice to detail him as an assistant instructor in order to show the next boy in line how the work is done. As a teacher, the boy gains valuable experience and his ability is tested. The apprentice under this system gains confidence in himself and his ability is often recognized long before his apprenticeship is finished, so that he is guaranteed steady employment on some work that will in time lead to a foremanship if he continues to improve.



Charts, Models and Tools in the Erie Apprentice School at Dunmore, Pa.

Tunneling the English Channel.—Baron d'Erlanger, chairman of the Channel Tunnel Company, lecturing recently in London, on the construction of the channel tunnel, said the line of the proposed tunnel would be from behind the forts at Dover, dipping down under the Channel to a maximum depth of 100 yards and then rising gradually to the French shore. Beneath the main tunnels, in which ultimately the trains would run, would be a small drainage gallery, and it would be by using this gallery for a small line of railway that the 1,200 workmen would be conveyed to the scene of operations every morning and the debris brought out. Sir Francis Fox, engineer of the company, said he had spent the best part of forty years of his life tunneling under water and through mountains and under the streets of London, and had had far greater difficulties to contend with than they expected to encounter in tunneling the channel. For example, they would have no scalding water or hot rocks to deal with, as in the case of the Simplon Tunnel; nor would they experience the difficulty they had in driving a tunnel under the Mersey from 1880-86. Difficulties and risks were today reduced to a minimum.—*The Engineer*.

An Efficient Wheel Shop

The Methods and Equipment Employed in Car Wheel Repairs and Renewals on the Soo Line

BY B. N. LEWIS
Assistant Foreman, Shoreham Shops, Minneapolis, Minn.

The wheel shop of the Minneapolis, St. Paul & Sault Ste. Marie, at Minneapolis, is a good example of what may be accomplished, in laying out a shop, by making a careful study of the work to be done. When the space first allotted to this work had been outgrown a new shop was planned and built by the local forces, and, while there have been a few changes in the locations of the different machines, the shop has proved to be efficient from the start. With the present equipment it has a capacity of 2,000 pairs of wheels a month. Under average conditions, however, the shop has an output of 1,500 pairs of wheels, with 18 men working 25 days of 9 hours each, at an average cost of 84 cents per pair of wheels. This includes the turning or re-tiring of about 210 steel tired wheels, dismounting all scrapped wheels, handling all new and scrap material, loading and unloading all wheels, checking, accounting, etc.

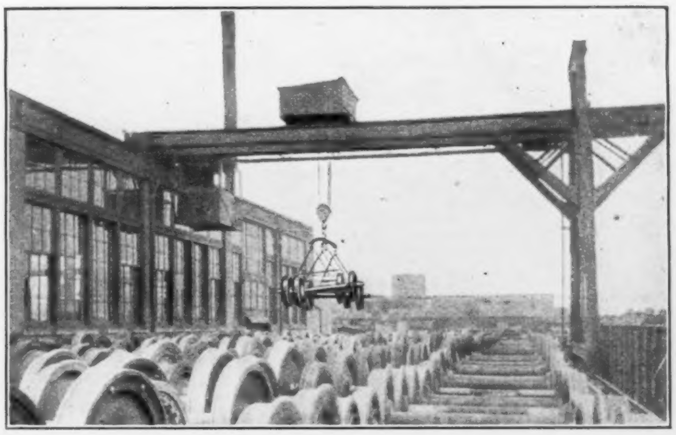


Fig. 1—Platform for Storing Mounted Wheels

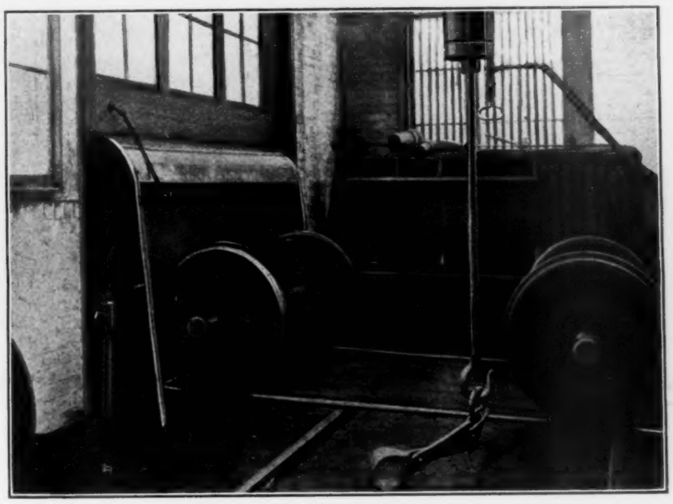


Fig. 2—Balanced Doors for Mounted Wheels

The shop has a depressed spur track on each side with a 40-ft. platform on the south side, and a 50-ft. platform on the north side. Both platforms are level with the car floor. The 40-ft. platform is used for storing unfitted wheels, axles, tires, etc. The floor of this platform is made of old car sills and is of sufficient length to accommodate six cars at one time. The 50 ft. side is equipped with tracks for storing the mounted wheels. The wheels are also received on this side from the road, the cars being unloaded by means of a 5-ton Gantry crane, as shown in Fig. 1. It will be noticed that a special hook is provided that will lift four pairs of wheels at a time just as they are located on the car.

As the worn wheels are taken from the car they are placed on a transverse track entering the building at the east end, and are passed through a swinging door, shown in Fig. 2. There are two such doors used in the shop, the other being at the west end on the same side where the finished wheels are run out of the shop. These doors are made of wood covered with sheet iron and swing on a pivot near the top. Weather strips are provided on all four sides. They are easily operated by simply pushing the wheels through them. They will allow very little cold air to enter the shop, and are an excellent arrangement,

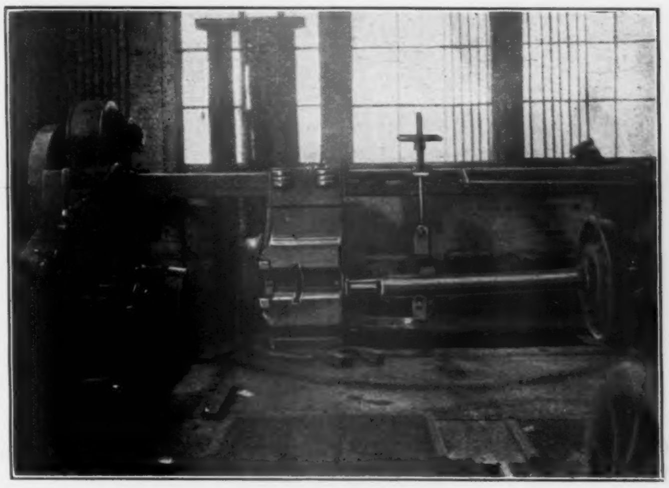


Fig. 3—Dismounting Press Showing Scrapped Wheel Ready for Lifting

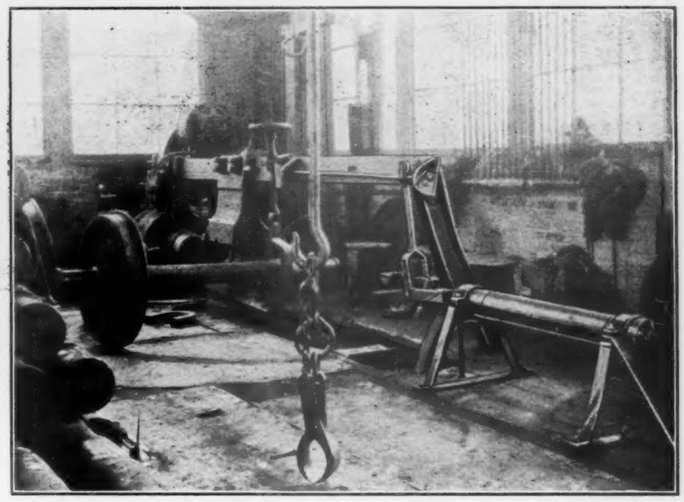


Fig. 4—Another View of the Dismounting Press Showing Air Cylinder and Grab Hook

both from the standpoint of time and of keeping the shop warm in winter.

After the wheels have been pushed through the swinging door they continue across the shop, the track having a slight descending grade to the dismounting press shown in Figs. 3 and 4. This press is arranged to be operated by one man and has many unique features. The platform in front of it is removable, being set flush with the floor for 33 in. wheels, and may be re-

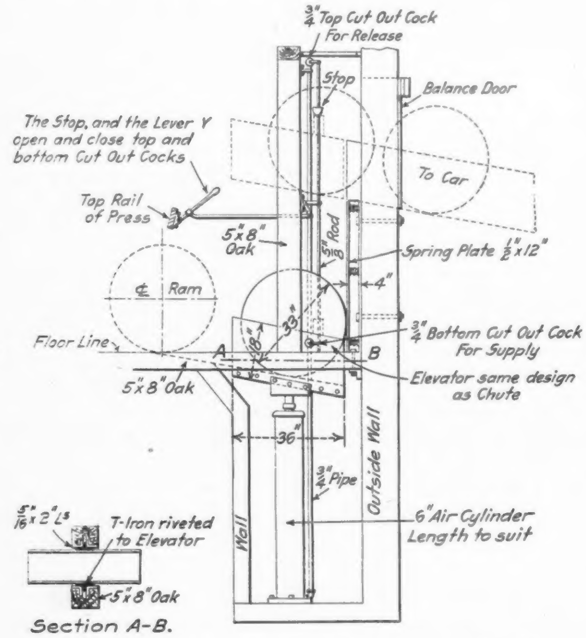


Fig. 5—Hoist for Lifting the Scrapped Wheels

placed by others of different heights to facilitate the handling of wheels of different diameters, the purpose being to have the axle in line with the jaws of the press. The top of the platform is covered with an iron plate.

When a wheel that is to be scrapped has been removed from the axle it is rolled down a short incline back of the machine to an air lift, a drawing of which is shown in Fig. 5. The wheel is then raised and placed on a chute which passes through the side of the building down to the south platform where the

Fig. 6—Chute for Passing Scrapped Wheels out of the Shop

wheel is either stored or rolled to an awaiting car; the chute is shown in Figs. 6 and 7. The wheels that are not to be scrapped are kept in the shop to be mated and re-applied.

After one wheel is removed, the other wheel with the axle is pulled out of the press jaw a certain fixed distance, as shown in Fig. 3, by a grab hook operated by an air cylinder, the arrangement being shown more clearly in Fig. 4; a detail drawing of the grab hook is given in Fig. 8. The wheel outside of the jaw is placed on a small carriage to facilitate this operation and the axle is supported by a swivel hook provided with a roller;

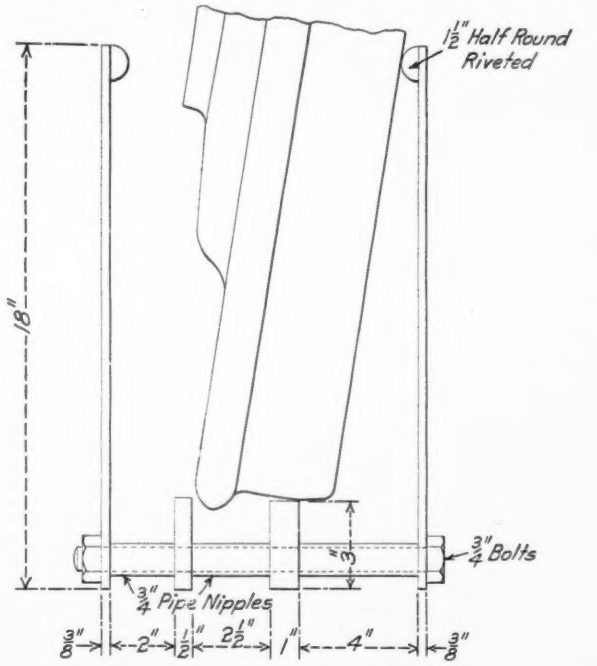


Fig. 7—Design of Chute for Scrapped Wheels

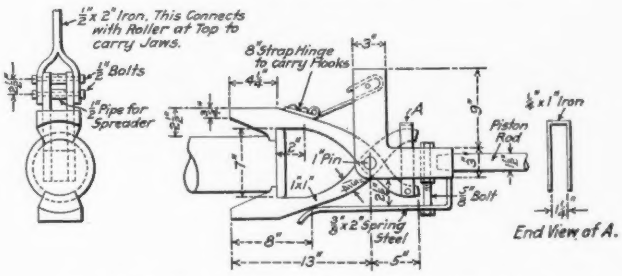


Fig. 8—Design of Hooks for Dismounting Press

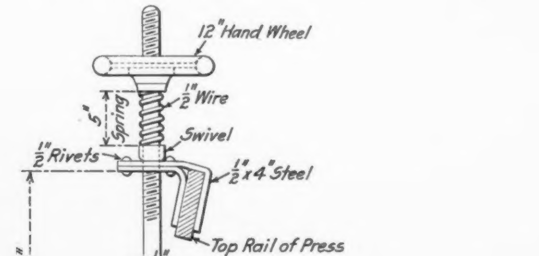


Fig. 9—Swivel Hook for Dismounting Press

this hook is shown in Figs. 3 and 4, and in detail in Fig. 9. The wheel is then rolled around, as indicated in Fig. 4, and placed

on the press so that it too may be removed. The axle is then removed and placed in the proper pile, for inspection. With this equipment one man can easily strip 11 pairs of 33 in. cast

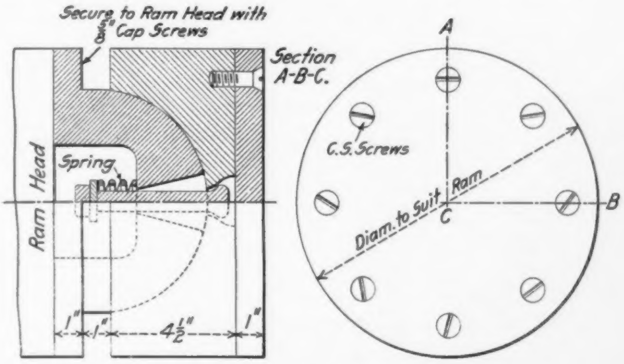


Fig. 10—Swivel Head for Dismounting Press

iron wheels an hour, properly marking and handling all the axles and reclaimed wheels.

The head of the ram of this press is fitted with a flexible head, as shown in Fig. 10. This eliminates all danger of bending the journal in case it is not directly in line with the ram, due to an obstruction on the inside of the wheel preventing it from seating squarely on the jaws of the press.

Fig. 11—Axles Ready for Fitting

After the axles are inspected and turned, if necessary, they are grouped for size and placed in piles, one axle high, as shown in Fig. 11, for the convenience of the wheel borer. When the wheels have been fitted to them they are taken to the mounting press shown in the background of Fig. 11, by a mono-rail crane. They are then lifted by an air hoist on a jib crane and fitted to the wheels in an air-operated press shown in the foreground of Fig. 12 and in the background of Fig. 13. This press is made up of a rigid head and a movable head, the latter being operated by an air cylinder which is controlled by a four-way cock shown half way between the heads so that the operator may operate the machine and guide the axle at the same time. This press is mounted on two 5 in. I-beams and the heads or supports are made of ½ in. steel plate. This arrangement greatly expedites the locating of the wheels on the axle and insures that they are started true. The space between this preliminary press and the hydraulic mounting press will accommodate five pairs

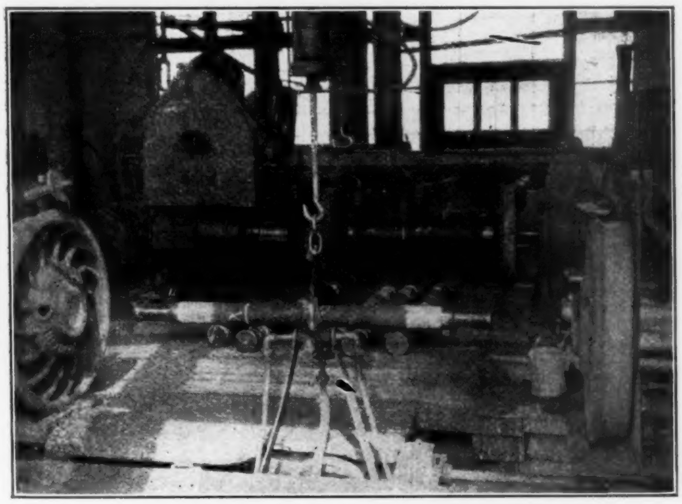


Fig. 12—Assembling and Mounting Press

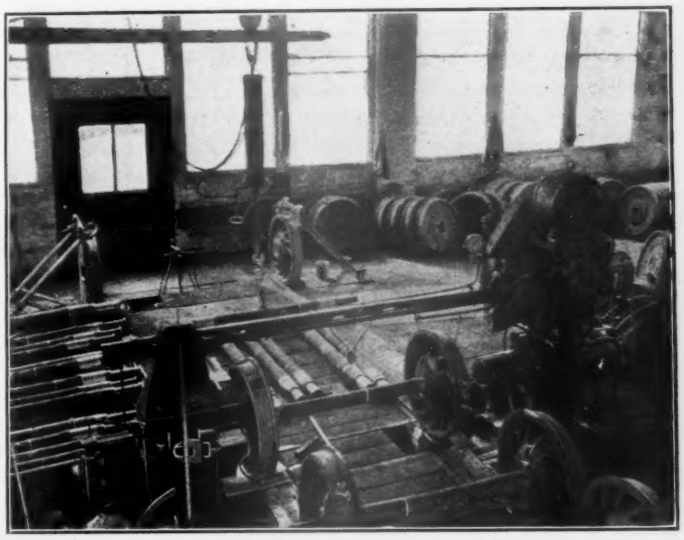


Fig. 13—Assembling and Mounting Press Looking in the Opposite Direction from Fig. 12

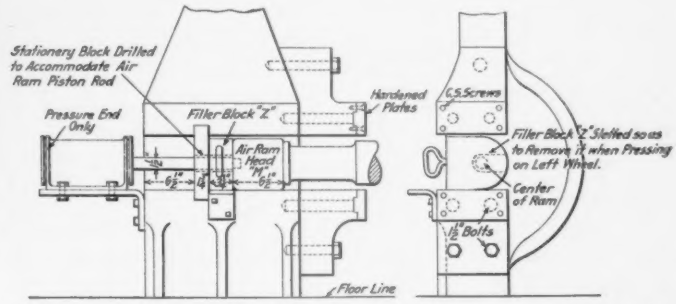


Fig. 14—Arrangement of Outboard Housing for Mounting Press

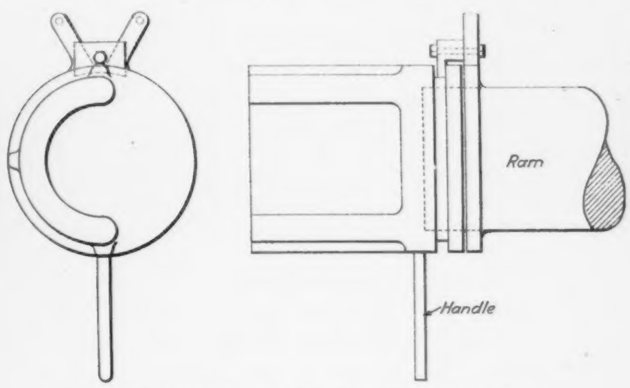


Fig. 15—Attachment for Mounting Press Ram

of wheels. The hydraulic press, being of an old design, is provided with special jaws fitted to the outboard housing, as shown in Fig. 14, and an offset piece, the detail of which is shown in Fig. 15, is fitted in a groove in the ram head This offset piece bears on the wheel and is cut away to receive the end of the axle. It is also free to revolve on the ram so that after the wheels are pressed on, they can be passed on through the machine. The outboard housing is also provided with an air plunger, as shown, to push the wheels over in line with the outgoing track after they have been forced on, and to also push the axle over so that a filler block *Z*, Fig. 14, may be admitted, thereby lifting the near wheel off the housing when it is desired to force the other on the axle a little more. With this arrangement one, two or four men can work to advantage. One man will average 50 pairs of 33 in. cast iron wheels a day; two men, 100 pairs, and four men, 170 pairs. The hydraulic press is provided with a recording gage, whereby a complete record of the pressure used in forcing on each pair of wheels is obtained and this is kept for future reference.

The steel tired wheels are handled outside of the shop in a special fuel oil tire heater made by the Mahr Manufacturing

Fig. 16—Fuel Oil Heater Which Is Placed Outside the Shop for Heating the Tires of Steel-Tired Wheels

Company, Minneapolis, Minn. This heater is shown in Fig. 16. One man handles this entire work with the aid of a jib crane and can replace one steel tire an hour, including the removal and replacing of the retaining rings, at a cost of 27 cents per wheel. The heater will remove an average of 126 worn out 40 in. tires in nine hours, and will heat 54 new 40 in. tires in the same length of time. It is lined with fire brick 4 in. thick, and the body is cast iron ⅞ in. thick; the covers are all operated by one lever. After the first tire is heated the machine lights itself from the heat of the bricks. To operate this machine, the wheel is placed in the heater and the burner lighted. When the tire expands the wheel drops through to the truck below. The truck is then pulled out and a new tire heated and placed on the wheel. A new tire can be heated and slipped over the wheel and another tire placed in the heater while the first tire is being set and another wheel made ready. This will take about six minutes and allow time for the second tire to be heated. This makes a continuous performance and enables the man in charge of the work to complete a wheel every six to seven minutes.

INSTALLATION AND MAINTENANCE OF ELECTRIC HEADLIGHT EQUIPMENT

BY V. T. KROPIDLOWSKI

V

We now come to the conversion of the electric energy to a light producing agent. The older forms of illuminants, oil and gas flames, have met more or less successfully the rather exacting conditions and have very largely determined the type of fixtures and reflectors in use at present; but the flame lamps are at best only markers. The intrinsic brilliancy of the oil flame is very low, and the flame cannot be concentrated near the focal point of a parabolic reflector.

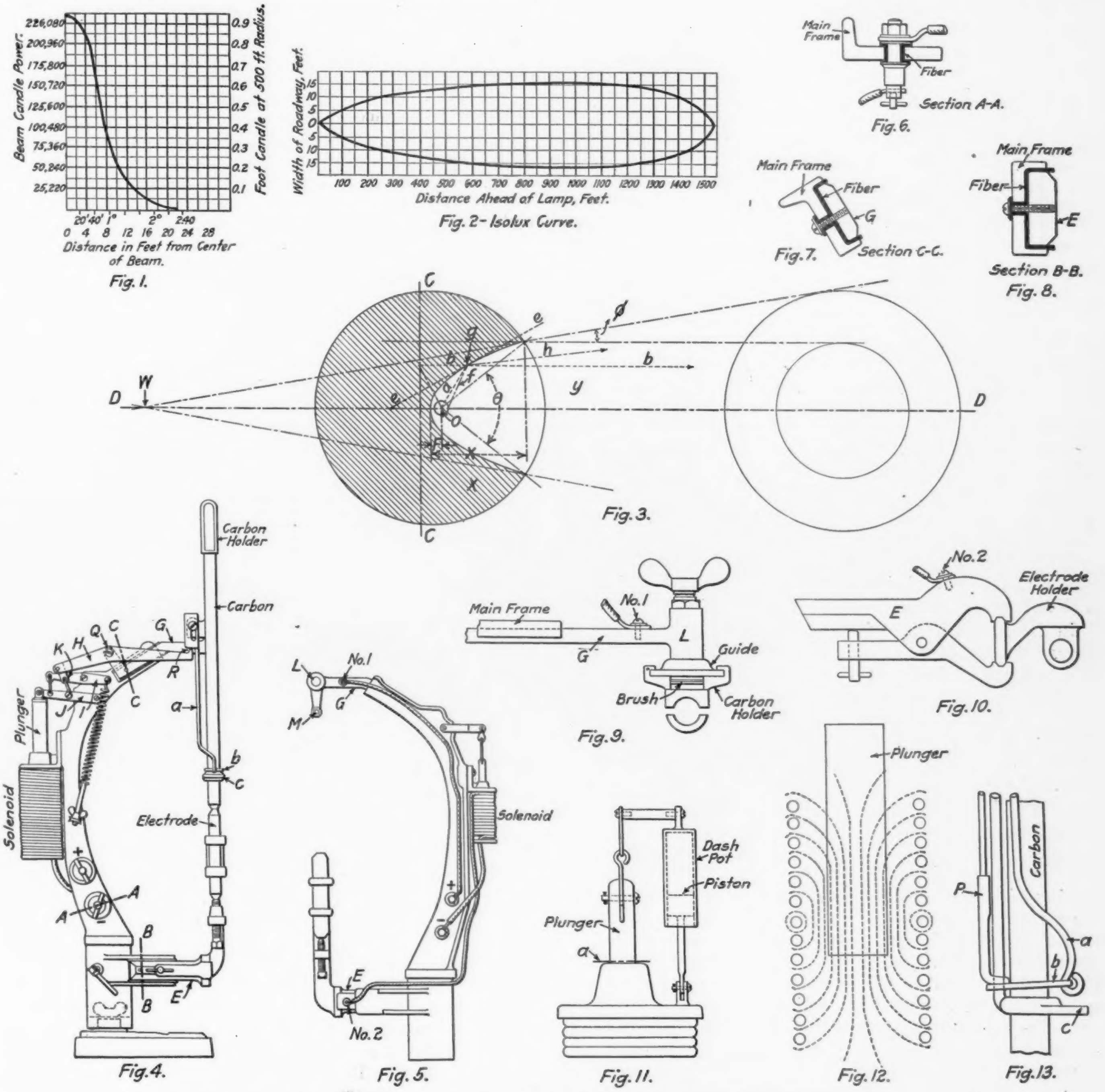
The electric arc is a very powerful light source of small volume, and if backed by the proper reflector produces a dazzling beam of light. The wonderful progress being made in the manufacture of incandescent lamps puts this lamp in the field as a strong rival of the arc lamp, and the writer believes that it will not be long before it will replace the arc, considering that the arc lamp is not very well adapted, as far as the regulating mechanism is concerned, to the severe conditions met on a locomotive. The advent of the tungsten filament lamp has made possible constructions with the incandescent material wound in close spirals so as to occupy a small space, within a sphere of about ¼ in. to ½ in. diameter, which makes it more suited as an efficient light source in the parabolic reflector. These lamps can be furnished for the voltage now used (30 volts), but if a lower voltage could be fixed upon, a sturdier filament would be the result and with the improvements in storage batteries it should be possible to obtain conditions approaching much closer the ideal.

Figs. 1 and 2 show respectively the candle power distribution curve of a 50 c. p. incandescent lamp in a 20-in. reflector, measured at a distance of 500 ft. at the center of the beam and at intervals of one foot to one side of the center, and an isolux curve showing the distance and width of the track illuminated to 1/10 foot-candle. The distribution curve is an actual photometric measurement, but the isolux curve is calculated from the distribution curve on the assumption that the candle power varies according to the law of inverse squares. It is seen, from this approximate computation, that an incandescent lamp of as low c. p. as this is sufficient for this service. By tests made by some railroads the indications are that an intensity of from 0.05 to 0.10 foot-candle thrown on a man wearing dark clothes renders him visible at from 800 ft. to 1,000 ft. Of course the present state laws will not allow a lamp of such low candle power; 1,500 c. p. without the aid of a reflector is what a number of the states prescribe, but with the progress being made in the improvement of the incandescent lamp the manufacturers should before long have developed an incandescent lamp for headlight service which will meet the requirements of the law.

The surface used in the design and construction of the parabolic reflector is the paraboloid of revolution, a surface generated by revolving a parabola about its axis. A parabolic curve is developed from a fixed point and a fixed line. The fixed point is *O*, Fig. 3 and the fixed line, *cc*. The line *bb*, called the diameter, is perpendicular to the fixed line *cc* and is therefore at all times a horizontal line. The line *a*, called the radius, pivots about the fixed point *O*. By making the lines *a* and *b* of equal length to the point of intersection a number of points *g* will be obtained and a line drawn through these points will be the parabolic curve. It is evident, therefore, from the construction of the parabola that the two lines *a* and *b* make equal angles with a line *ee*, called the tangent, and consequently with the surface of the parabolic reflector. So, if we were able to concentrate a powerful light source at the point *O*, every ray emanating from it would be reflected in a straight horizontal line, and we would multiply the intensity of the light source as many times as there were rays; if the intrinsic brilliancy of each

ray was equal to one candle power we would have a total candle power equal to the number of rays. The beam of light composed of the reflected rays is not covered by the law of inverse squares, but in a clear non-absorbing medium will be projected to infinity without increase or decrease of intensity; that is, if theoretically perfect conditions could exist, which is impossible.

We cannot concentrate a practical light source so that it will lie wholly within the ideal focal point, a dot; some of it must of necessity be without the focal point, and these rays emanating from the surface that lies without the focal point will not be projected in parallel rays, but will diverge or converge according to whether they come from the surface ahead of the focal point or from behind it. The reason that the rays outside of the focal point are not projected parallel to the axis of the parabola is that in the case of a polished reflector that law governs which states that the angle of reflection equals the angle of incidence. By again referring to Fig. 3, if we consider a ray of light *f* emanating from the surface of the light source that lies in front of the focal point, we no longer have the true condition upon which the parabolic curve is based. The radius *f* is no longer equal in length to the diameter *b*, and consequently the tangent *ee* is tipped on its point *g* slightly to the left; as a result the line *b* will not be parallel to the axis but will reflect in the direction of the line *h*. The fact that commercial light sources depart widely from the theoretical point sources, and that we can only approximate the theoretical conditions in practice, causes no ill effect in the case of a locomotive headlight; in fact, it is a benefit, as if all the rays were projected parallel to the axis and all coincided, the area illuminated by the beam would be a circle equal in diameter to the reflector, which would not be suitable for illuminating the space ahead to any practical advantage. What is required is a beam that will spread enough to illuminate the road at least fifteen feet to each side of the center. The spread of the beam is governed by the ratio of the



Candle Power Diagrams and Arrangement of Electrodes, etc., in Electric Headlights

focal length to the diameter of the reflector and must be determined upon in the design. Emphasis is here placed on the necessity of focusing the lamp properly, for the beam candle power depends on this more than on anything else; moreover, if the lamp is not properly focused, shadows will appear in the beam. Of course shadows will sometimes be present even though the lamp is accurately focused, but they are due to defects in the reflector, such as dents, rough surfaces, etc.

Let us assume now a concrete case and apply the above conclusions to it, maintaining ideal conditions. Referring once more to Fig. 3, take $y = 9$ in. and $x = 13$ in.; the focal length F will be in this case 1½ in. and the area of the beam will be 1.75 sq. ft. A uniform source of one candle power placed at the center of a sphere of one foot radius illuminates every point on the interior of the sphere to the intensity of one foot-candle. The area of the surface of the sphere is 12.57 sq. ft., hence, the total quantity of light given off by a source of one candle power illuminates an area of 12.57 sq. ft. to an intensity of one foot-candle. The term lumen is used to denote the quantity of light received on each square foot of surface; thus a light source of one spherical candle power will produce an intensity of one foot-candle over 12.57 sq. ft., or 12.57 lumens.

There will be a cone of light as shown by θ which will not be under the influence of the reflector and will be subject to the law of inverse squares, and which when subtracted from the area of the whole sphere leaves us 11.43 sq. ft. An ordinary arc lamp using copper for the negative electrode produces about 1,300 mean spheral candle power; the total light flux will then be 1,486 lumens, which divided by the area of the mouth of the reflector, 1.75, gives an average of 8,490 lumens per square foot on the cross section of the beam of light. At a distance of one foot from the source the candle power of a lamp at the same point would be 3,919, and at 100 ft., according to the law of inverse squares, and on the assumption that the intensity of a reflected beam does not decrease, it would be equal to a lamp placed at the door of the reflector and equal to $100 \times 100 = 10{,}000$ times $8{,}490 = 84{,}900{,}000$ c. p.

In the case of a divergent ray, if we assume Φ equal to one degree, the sine of which is .0175, we can calculate the field that will be illuminated at any distance; for instance, at 1,000 ft. the field illuminated will be $0.0175 \times 1{,}000 = 17.5 \times 2 = 35$ ft. in diameter. The divergent ray projected backward will cross the line DD at W, approximately 44 ft. from the front of the reflector. The average illumination at the front of the reflector will be the same as for the parallel ray, as we are not changing any physical details but merely mathematical; to produce this illumination with an unreflected light source at W will require a lamp of $44 \times 44 \times 3{,}919 = 16{,}436{,}640$ c. p. The illumination at any other point in front of the reflector may be computed by the law of inverse squares by using this value and referring to the point W as an origin. We can then refer to the lamp as equivalent to a 16,436,640 c. p. source. If we use an incandescent lamp of 100 candle power in place of the arc lamp, we will obtain $11.43 \times 100 = 1{,}143 \div 1.75 = 653$ lumens per square foot, and an equivalent candle power at W of $44 \times 44 \times 67 = 1{,}250{,}290$.

We can now calculate the approximate illumination of the road ahead of the locomotive. At 5,000 ft. the arc lamp will give $16{,}436{,}640 \div (5{,}000 \times 5{,}000) = .65$ foot candles at the center of the beam and at 1/10 foot-candle at that distance $.65 \div 0.1 = 6.5$; the square root of $6.5 = 2.56$, the distance in feet which will be illuminated at the side of the road bed. With the incandescent lamp, at 1,500 ft. ahead we obtain $1{,}250{,}290 \div (1{,}500 \times 1{,}500) = 0.54$ foot-candles at the center of the beam and at 2.3 ft. to one side of the road 1/10 foot-candle. By a continuation of this process we can obtain any number of points along the illuminated way.

The principle of operation of the ordinary direct current arc lamp is as follows: The current from the positive brush of the dynamo comes by the way of the + binding post, Figs. 4 and 5, (Fig. 4 shows one side of the arc lamp and Fig. 5 the opposite side, Fig. 5 showing the connections plainer), and follows the wire to connection No. 1, through the bracket G, which is fastened at L and M to the guide which is not visible back of the carbon, and in Fig. 4 it enters the guide where it is picked up by a small brush that is fastened to the carbon holder and passes through the carbon holder into the carbon. The carbon and electrode being in contact, the current continues on through the electrode, through the small frame that supports the electrode to the bracket E, through the connection *No. 2* on the bracket E, shown plainer in Fig. 5, following the wire, which leads it into the winding of the solenoid at the upper end, through the solenoid winding and out at the bottom to the negative binding post; thence it returns to the dynamo. As soon as current passes through the solenoid it energizes it and creates a magnetic flux in its hollow center, in which the plunger is suspended. The magnetic flux tries to equalize itself through this iron plunger and thereby pulls the plunger down. The plunger being connected to lever J pulls this lever down with it, and lever H being connected with lever J also is pulled down; H being pivoted at Q, this movement causes the end at R to rise, which lifts rod a, which in turn tips the clutch b until it clamps the carbon and lifts it along with it. When the carbon is lifted the contact is broken between it and the electrode and the current trying to continue on its course establishes the arc; of course the carbons are separated just enough so that the voltage available at the arc is able to continue forcing current through the air gap, and as the upper carbon burns off the air gap becomes greater, the voltage not being able to maintain current through the widened gap, the solenoid loses its energy and allows the upper carbon to drop; the latter comes in contact with the electrode again and current starts flowing anew, repeating the operation.

The insulation is of prime importance and misunderstanding or negligence may cause much damage and expense. The operator as well as the attendant should be sure whenever it becomes necessary for any reason to disturb any of the insulators, to see that they are put back properly. Cases are not lacking where lamps have been burned out due to just such negligence. If the + and — binding posts were not insulated from the main frame a dead short circuit would exist, and if something does not give way at the arc lamp to break the current's path, the dynamo winding will burn out; this would also happen in case any two opposite polarity insulators were left out. For this reason the writer has made it a point to bring out all the places of insulation in the detail drawings. Fig. 6 is a section taken through binding post and frame on the line aa, Fig. 4; the insulation denoted by the word fiber to which arrows point is shown by cross lines and the other members of the detail are not cross hatched in order to bring out the insulation clearly. Fig. 7 is a section taken on the line cc, where the small bracket G is fastened to the main frame. Fig. 8 is a section taken on the line bb, where the lower bracket E is attached to the main frame. The importance of insulating these two brackets from the main frame will be seen, as if they were not insulated there would be nothing to prevent a short circuit, and the current would not go through the carbons to create an arc but would pass through no resistance, but through the main frame directly to the generator. But one make of lamp is illustrated for the reason that the principles of operation are the same, only they vary somewhat in detail.

Figs. 9 and 10 show respectively, in larger detail, the upper bracket G and the lower bracket E; these drawings are self-explanatory. The numerals and letters that are the same in the different figures represent the same parts.

Fig. 11 shows the dash pot, which is a small cylinder with a piston. Its function is to steady the action of the solenoid plunger. If this dash pot were not there, the plunger would be pulled in with a jerk, probably beyond the equalization zone of the magnetic flux, and a seesawing would take place resulting

in a make-and-break arc. The dash pot should be removed occasionally and the cylinder wiped out, but no oil should be used to lubricate it, as oil will gum and cause the arc to jump, and will get under the seat of the little ball valve. If the cylinder shows considerable wear by evidence of the piston being loose, it should be renewed. The suction in the cylinder is regulated by a little ball valve in the piston; this should be kept in good working order.

Fig. 13 shows the clutch that lifts the carbon; *C* is the rigid frame support and also a guide for the carbon and *a* is the lifting rod attached to the clutch *b*. The clutch is horseshoe shaped with an opening large enough for the carbon to work freely in it. The upper end of the rod *P* works in a socket having a coil spring, and when the rod *a* pulls up, the rod *P* pushes down on the heel of the clutch, which action sets the clutch on an incline and thereby grips the carbon and lifts it. The tension of the spring in the socket that pushes down the rod *P* can be regulated, so that in case the clutch does not grip the carbon early enough in the stroke the tension of the spring can be increased, causing more pressure on the rod *P* so that it will trip the heel of the clutch earlier in the stroke and cause the clutch to grip the carbon and raise it before the plunger gets down too low in the core of the solenoid.

The spring shown in Fig 4 is also there for the purpose of steadying the movement of the plunger, but acts mainly as a counterweight for the upper carbon and the levers. It can also be regulated to suit conditions. The link *K*, Fig 4, is also a very important detail, as it is of fiber and is an insulator as a second precaution between the positive and negative sides of the wiring. Care should be taken not to replace this link with a metal one.

The principle of the operation of the solenoid and the plunger is shown in Fig 12. The dotted lines represent the lines of magnetism that are created by the current passing through the winding, which is represented by the small circles. It will be noticed that the lines of magnetism are most numerous at the middle of the length of the solenoid, which explains the pulling in of the plunger. The pull is greatest before the plunger reaches over the middle point, and when the lower end is flush, or very nearly so, with the lower end of the solenoid, there will be no pull, as then an equalization takes place and there is just as much pull up as there is down. In case the momentum created by the sudden pull brings the plunger beyond the equalization point, as mentioned earlier in the article, there will be a sudden pull upward again, for the reason that the plunger has passed over the middle point; this is what causes the jumping and seesawing mentioned before. The regulating springs, etc., are provided to cause the plunger to separate the carbons before arrival at this unsteady point.

There is a difference between the copper electrode's burning, being consumed, and melting. If it is being consumed, which is evidenced by the tip becoming dull and short, the voltage is too high, which may be remedied by reducing the speed of the turbine. If the copper is found to be melted, the voltage is too low or the regulating mechanism is defective. To remedy this, light the lamp and let it burn a short time, scribe a line on the solenoid plunger, having previously chalked it so the line will be visible, as at *a*, Fig. 11. Cut off the current, allow the carbons to cool and pull down the plunger till the line is even with the base of the solenoid, which will bring the carbons to the same position they were in when the plunger was marked. Now measure the distance between the carbons, and if it is found that they are not 1/16 in. apart, lengthen the spring that operates the lever *P*, Fig. 13, or shorten the link that connects the plunger to the lever *J*, Fig. 4. Light the lamp again and mark the plunger the same as before, cut off the current and measure the distance the electrodes are now separated, and if still less than 1/16 in., bend up the end *R* of lever *H* until the proper distance is obtained between the electrodes. Numerous cases have come to the writer's attention in which the wrong end of the equipment was being treated for the trouble, that is, instead of adjusting the lamp for fused coppers, the speed of the generator was reduced and, as a consequence, the trouble was augmented, as low voltage will also fuse the copper.

The copper electrode fuses because the arc is too short and does not allow the lava from the crater of the carbon electrode to remain and protect the tip of the copper from the intense heat of the positive pole or upper carbon.

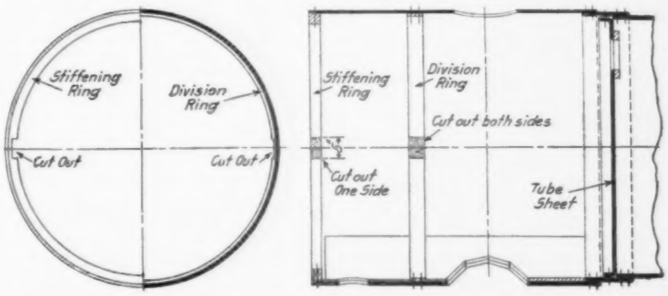
If the lamp will not burn when the locomotive is running but burns when it is standing, the trouble is with the clutch *b*, Fig. 13. It is usually worn oblong or the edges are worn round. In this case the clutch should be renewed. The reason the lamp does not burn when the engine is running is because the clutch will not grip the carbon sufficiently to prevent the jarring of the locomotive from shaking the upper carbon down on the lower one. This must be remedied at once, for when the carbons touch when the generator is working and the lamp is cut in they permit a short circuit, overheating and warping the regulating mechanism and probably burning out the armature winding of the generator.

REMOVING FRONT TUBE SHEETS

BY PAUL R. DUFFEY

The removal of a damaged or badly worn front tube sheet from a locomotive boiler is, with the best known methods, a long and tedious operation. The method here described is one that has proved to be more satisfactory than some the writer has seen used, and is the practice at the Norfolk & Western shops at Portsmouth, Ohio.

A piece about 4 or 5 in. long is cut out of one side of the smoke box stiffening ring. This piece is taken out on the horizontal center line of the smoke box and extends an equal distance above and below the line. A piece of the same length is then cut out to one-half the depth of the smoke box division ring, on both sides of the smoke box and on the same horizontal center line as before. After all the rivets and braces have been removed from the tube sheet, it is pulled over to a horizontal position and removed from the front end through these slots. It has been found that after the new sheet is put in place it is not necessary to set a piece in the division ring, as it is not materially weakened. A piece is fitted and riveted in the stiffening ring, holes being provided for holding the front in place. The time required to do this work under ordinary conditions is from 12 to 15 hours.



Method of Cutting Rings to Remove a Front Tube Sheet

CAPE TO CAIRO RAILWAY.—The Cape to Cairo Railway is now at Kambove, 800 miles beyond the Victoria Falls and 300 miles inside the Congo border. A further extension of 100 miles to Burame is about to be commenced. Within a brief period there will be communication from the mouth of the Congo at Boma right across Africa to Dar-es-Salaam.

ABRASIVE WHEELS

BY C. J. MORRISON

A frequent sight in machine shops is an abrasive wheel worn down too far below its useful size and running at so slow a speed that grinding is almost impossible. Such a wheel is the acme of false economy, as it not only wastes productive time every day, the value of which is far in excess of the price of a new wheel, but entails other losses due to poorly ground tools. Even though it may be possible to properly dress a tool on such a wheel—usually it is not possible—the average mechanic has not the necessary patience.

Another source of loss is from wheels of improper grain or grade, or both, for the work. This loss is not so easy to detect, but is fully as prevalent as the first.

Still another frequent sight is two wheels of different diameters mounted on one spindle and neither running at the proper speed. Of course, it is impossible to run both at the right speed.

Losses due to improperly dressed wheels are due to pure neglect and need not be considered. The other troubles usually come from the fact that no one is particularly interested in the wheels, or, if interested, has neither the time nor the knowledge necessary to attend to them.

The purchasing agent is usually interested in having the wheels last a long time, and orders frequently stipulate that the wheels must be harder than the last shipment as they wore out too soon. Also orders often simply call for one wheel of a certain size, and no specifications as to grain, grade, or use are given.

In order to produce economies and to secure the desired results, the grinding problem must be intelligently studied. Proper grinding is nothing more or less than cutting, and one wheel is no more fitted for all kinds of grinding than one tool is capable of all kinds of cutting. A wheel that will grind high speed steel tools is almost useless for brass.

Few can devote sufficient time to the subject to become experts on abrasive wheels, but almost any one can become sufficiently posted on the basic essentials to be able to intelligently select, install and maintain the wheels.

The grain of a wheel is represented by a number which refers to the mesh of the screen through which the grain will pass when in the dry state. Consequently, the higher the number, the finer the grain. Grade refers to the quality of the abrasive as to whether it is hard or soft, and the different grades are represented by letters, the first letters of the alphabet representing the softest and the abrasive becoming harder as the letters progress. As an example, 30-0 represents a grain which would pass through a 30-mesh screen and a medium grade. In large wheels this is adapted to the grinding of medium high speed steel tools.

Unfortunately, the grading is not exactly the same with different makes of abrasive wheels so that a combination which is satisfactory in one make may not be as efficient in some other case. However, the following specifications may be used as a guide:

Class of Work.	No. of grain or degree of coarseness usually furnished.	Grade letters or degrees of hardness usually furnished.
Large cast iron and steel castings	16 to 20	P to Q
Small cast iron and steel castings	20 to 36	P to Q
Large malleable iron castings	16 to 20	Q to R
Small malleable iron castings	20 to 30	P to Q
Chilled iron castings	16 to 20	R to T
Wrought iron	16 to 30	O to P
Brass and bronze castings	20 to 30	P to R
Rough work in general	16 to 30	P to Q
General machine shop use	30 to 46	O to P
Lathe and planer tools	30 to 46	N to O
Small tools	46 to 100	N to P
Wood-working tools	36 to 60	M to N
Twist drills (hand grinding)	36 to 60	M to N
Twist drills (special machines)	46 to 60	J to M
Reamers, taps, milling cutters, etc. (hand grinding)	46 to 100	N to P
Reamers, taps, milling cutters, etc. (special machines)	46 to 60	H to K
Drop forgings	20 to 30	P to Q
Gumming and sharpening saws	36 to 60	M to N
Planing mill knives	30 to 46	J to K
Car wheel grinding	20 to 30	O to P

After selecting a wheel according to this table, its service should be carefully watched and alterations made in the grain and grade until exactly the right results are obtained. In general, if the wheel glazes, it is too hard, while if it wears away too rapidly, it is too soft. Also if the wheel has a tendency to burn the work, it is of too fine a grain. The manufacturers should be consulted and their co-operation obtained in the selection of wheels. After the proper specifications have been secured for each class of grinding, they should be made standard and wheels ordered accordingly instead of to suit the whims of workmen or foremen.

All grinding should either be done dry or with a copious stream of water. Nothing is more dangerous to the success of grinding than an inadequate or intermittent supply of water.

Assuming proper grain and grade to have been selected, the efficiency of grinding is directly proportional to the peripheral speed of the wheels. The manufacturers test wheels at a peripheral speed of 9,000 ft. a minute or over, and in practice they should be run between 5,000 and 6,000 ft. a minute. It is profitable to arrange so that wheels will make 6,000 ft. when full size, as by such an arrangement they can decrease considerably in diameter before becoming too inefficient to be profitable. The following table of peripheral speeds for different diameter wheels will be found useful:

Diam. of wheel. Inches.	Revolutions per minute for peripheral speeds. 4,000 ft.	5,000 ft.	6,000 ft.
1	15,279	19,099	22,918
2	7,639	9,549	11,459
3	5,093	6,366	7,639
4	3,820	4,775	5,730
5	3,056	3,820	4,584
6	2,546	3,183	3,820
7	2,183	2,728	3,274
8	1,910	2,387	2,865
10	1,528	1,910	2,292
12	1,273	1,592	1,910
14	1,091	1,364	1,637
16	955	1,194	1,432
18	849	1,061	1,273
20	764	955	1,146
22	694	868	1,042
24	637	796	955
30	509	637	764
36	424	531	637

Many grinding machines have entirely too few speeds. In fact, a large number have only one speed. The lack of proper speeds means decreased efficiency and should be avoided in the purchase of new machines. Sometimes where more than one machine use the same wheels they can be run at different speeds, and a wheel first used in a fast machine then transferred to a slower one. Each machine should be provided with instructions concerning the speeds for different diameter wheels. These ideas can very profitably be applied to the wheels supplied for general use in the shop.

One large shop has a number of grinders with two speeds and others with one speed, all using the same wheels. Signs mounted on the stands in plain sight tell when the belt is to be shifted to the faster speed, and when the wheel is to be removed and placed in the single speed machine, which is revolving even more rapidly. Signs on the latter tell when the wheel is to be finally scrapped. Incidentally a locked flange device prevents the wheels being run at the high speeds when they are of too large a diameter.

Stands for the wheels should be of very heavy, rigid construction, and should be firmly secured to good foundations. In cases where they must be placed on floors, large bases should be provided, and these should be fastened to the floor supports, not to the floor itself.

After all other conditions have been met, the final success and safety of grinding depend on the mounting of the wheels. Wheels should be mounted on spindles of ample size, between sufficiently large and heavy flanges, so concaved that they bear against the wheels at their outer edges only. Many wheels are labeled with pads of pulp or blotting paper which form a cushion for the flanges, and in addition to this it is desirable to use rubber or

leather washers a trifle larger than the diameter of the flanges.

Never crowd a grinding wheel upon an arbor. Don't mount it unless it is found to be an easy fit. Flanges should be at least one-third the diameter of the wheel, and one-half is recommended; always concaved, never straight or convex. Never mount wheels without flanges. To some this warning may seem unnecessary, but wheels are frequently found simply held by a small nut which is liable to crawl, and when forced in at the center will break the wheel.

If rests are used, they should be in good order, rigidly secured, and kept as close to the wheel as possible.

Keep the boxes well oiled so that the arbor will not become heated, thus causing expansion and possible breakage.

Wherever possible, cover the wheels with hoods of heavy flange steel.

As a final precaution and to insure efficient grinding, have some one definitely responsible for the wheels, their maintenance and use.

A PLANT FOR RECLAIMING ASBESTOS BOILER LAGGING

BY ALDEN B. LAWSON

In these times when every department head must economize as far as possible, we find experiments being made with a view to utilizing scrap material. One of these which has proved a success is a boiler lagging reclaiming plant. Previous to the inauguration of this plant, the scrap boiler lagging was thrown away as useless. The plant was installed at a cost not over $800, and is merely a lean-to against one of the larger buildings. It is covered with sheet iron and has a floor 18 ft. by 40 ft., this size answering the purpose for shops that have an output of from 60 to 70 locomotives per month.

On locomotives coming into the shop for repairs, from 20 to 25 per cent. of the lagging is broken in removing it from the boilers and in handling. While previously this would have been a complete loss, it is now ground, recast into blocks and put back in service at a very small cost compared with that of new material, with which it compares favorably in service results.

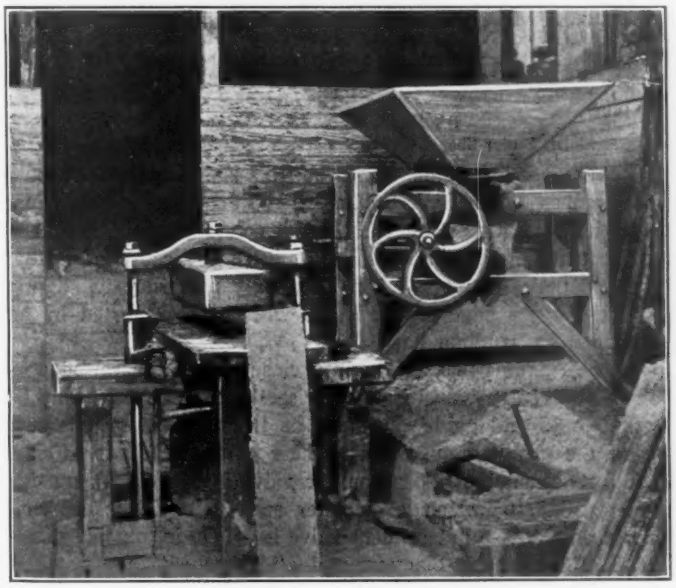


Fig. 1—Grinding and Picking Machine, Air Press and a Completed Sheet of Lagging

The plant consists of a storage bin for the old broken lagging; a homemade grinding and picking machine; a mixing vat about 4 ft. by 6 ft. by 12 in. deep; and a drying oven.

The grinding and picking machine is made as shown in Fig. 1. There is a wooden hopper on top into which the broken lagging is shoveled, after having been broken into pieces about 4 in. by 4 in. This hopper will hold about 1½ bushels; at the bottom is a breaker consisting of a cast or forged thimble, bored and keyed to a shaft and having six breakers or knives made integral with the body and projecting ½ in. above the outside circumference. This is shown in Fig. 2. The breaker revolves and bites or breaks the lagging as it wedges itself between the edges of the hopper and those of the breaker knives. The lower edge of the hopper is faced with iron and the edge next the breaker is turned up to prevent the lagging from falling through; it is set close enough to the knives to insure the lagging being broken into slender strips when it falls through to the lower box on the picker.

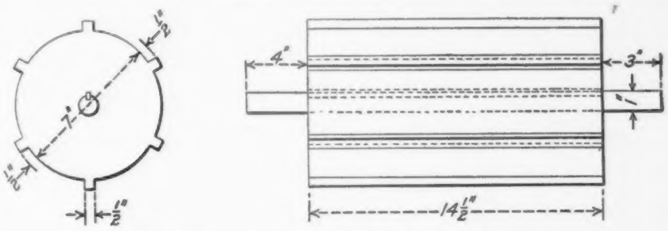


Fig. 2—Breaker for Boiler Lagging Plant

The picker is shown in Fig. 3 and is operated by a shaft which is geared to the breaker shaft. The speed of the breaker is 90 revolutions per minute, while 180 revolutions per minute is the speed of the picker. The picker is also made something like a thimble; it is bored and keyed to the shaft and the outer surface is filled with teeth about ⅜ in. in diameter and placed spirally. They extend about 1 in. above the surface and pass through slots in the toe plate which is secured to the side of the compartment as shown in Fig. 4. The lagging strips are thus picked apart and fall through to the lower compartment which has an inclined surface to direct the material to the mixing vat. The machine is operated by air, it being the most convenient in this instance.

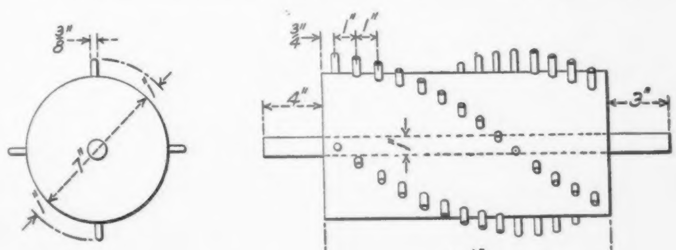


Fig. 3—Picker Used in Reclaiming Boiler Lagging

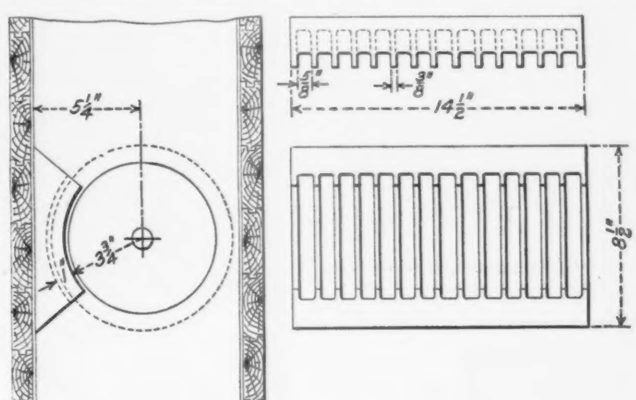


Fig. 4—Toe Plate Showing the Picker in Position

Another type of breaking machine may be made by the use of

a tumbling barrel made of wire netting of 2½ mesh. This is constructed along the lines of a flue or casting rattler, care being taken to bind the barrel sufficiently with iron strips to insure strength. A hinged opening should be provided for loading. In this barrel with the lagging are placed several pieces of scrap iron about the size and weight of a side rod knuckle pin. These crush and disintegrate the lagging and it sieves through the netting. This type of machine should be tightly boxed up to prevent dust flying and also to prevent the scattering and loss of the lagging. From 40 to 50 revolutions per minute should be sufficient speed to operate the barrel.

After the breaking and disintegrating the material is ready for

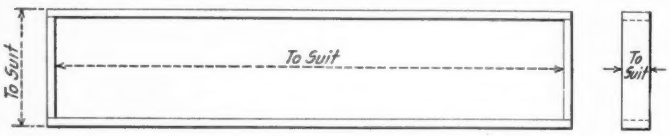


Fig. 5—Mold for Forming the Lagging Into Sheets

mixing, and if separated by a machine of the first type it will not require any binder. Where the material has been broken very fine, however, it will be found that a binder is necessary, and from 8 to 10 per cent. of asbestos cement will serve the purpose. This costs about four cents a pound and will not increase the cost of the work materially. Old hemp rope is also suitable if cut in pieces from 4 to 6 in. long and mixed with the ground lagging.

Sufficient water is added to permit the mixing of the material to a doughy mass, not too thin. After a thorough mixing it is poured in the wooden molds, Fig. 5, these being made any size

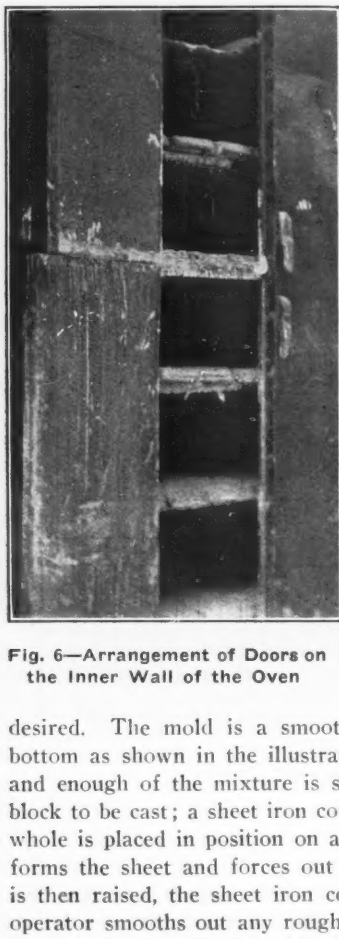


Fig. 6—Arrangement of Doors on the Inner Wall of the Oven

Fig. 7—Lagging Resting on Pipe Shelves in the Oven

desired. The mold is a smooth wooden frame, open top and bottom as shown in the illustration. It is set on a loose board and enough of the mixture is shoveled in to form the sheet or block to be cast; a sheet iron cover is then placed on top and the whole is placed in position on a table under the air press which forms the sheet and forces out all surplus material. The press is then raised, the sheet iron cover and mold removed and the operator smooths out any rough places in the sheet with a hand trowel; the base board with the sheet on it is then placed in the oven to dry, a process which requires about 24 hours. When removed from the oven the sheets are ready for use; one of the finished sheets is shown in Fig. 1, standing against the air press. The size of this is 2 in. by 7½ in. by 37 in. The cost of the labor for making a sheet is 2½ cents; to this should be added the cost of the binder. Considering all expenses, the cost per sheet should not exceed five cents, while the cost of a sheet of new material would be about 23 cents, making a saving of 18 cents a sheet. If one pound of asbestos cement were used for each sheet at a cost of four cents, the saving per sheet would still be 14 cents, but the cement is not often necessary. One man can make 110 sheets a day, which means a daily saving of $19.80, or about $6,000 a year.

There should be plenty of space allowed in the oven for drying the sheets. The oven can be placed against the outside wall of a building, but should be of double sheet metal and a space of 2 in. should be allowed between the walls. This space should be packed with ground asbestos and this also applies to the inner wall of the oven where the doors open to the inside of the plant as shown in Fig. 6. The doors should be lined with asbestos and fit closely. The depth of the oven should be at least 4 in. more than the longest sheet of lagging used. The shelves are formed of six or eight lines of 1½ in. steam pipe, and are built like a pipe radiator but placed horizontally; these shelves should be about 15 in. apart. The lower door should control as many shelves as a man can conveniently reach for placing the lagging sheets. If floor space is available all the shelves should be within reach from the floor so as not to necessitate the use of a ladder. In the case of the oven shown in Fig. 7, it is necessary to use a ladder to reach the upper shelves because of the lack of space. This illustration also shows the ends of the shelves with lagging sheets resting on them.

This work may be handled by an ordinary laborer. It would seem best to have such plants located at the main terminals only and have the smaller stations ship their old material in barrel lots to the point of location of the plant. In this way fewer plants would be needed and the operators, by working continuously would become more proficient and obtain better results.

JIG FOR GRINDING IN ROTARY VALVES ON E-T EQUIPMENT

BY F. W. BENTLEY, Jr.
Machinist, Butler Shops, Chicago & North Western, Milwaukee, Wis.

The absence of guide stems on the rotary valves of both brake valves of the Westinghouse E-T equipment sometimes makes it a difficult matter to hold the valves over the seat during the grinding operation. This is often the cause of annoyance and delay to work where it is only necessary to slightly grind the outer edge of the valve when it is reported by an engineman as handling hard.

Wooden guide rings which drop closely over the raised portion of the rotary valve seat, but rise slightly above it, may be used to hold and guide the valve as it is rotated on the seat during the grinding operation. These rings are made of oak. That for use on the H-6 automatic valve is 4 11/16 in. outside diameter, 3 3/16 in. inside diameter and ⅞ in. thick; the ring for use on the H-6 independent valve is 3 1/16 in. outside diameter, 2 1/16 in. inside diameter and 7/16 in. thick.

The rings are lifted quickly from around the seat when it becomes necessary to wipe it for a dry polish with the valve. In connection with such work on brake valves in both the back shop and the roundhouse, these jigs have proved of great assistance in obtaining rapid and satisfactory results.

Narrow Gage Dining Car.—The South African Railways have recently put in traffic on the Kalabas Kraal-Hoetjes Bay line, which is a 2-ft. narrow gage line, a dining car service. The car is a converted guard's van, which seats eight persons, and has been fitted up according to the suggestions of the catering manager.

NEW DEVICES

THE YOUNG VALVE GEAR

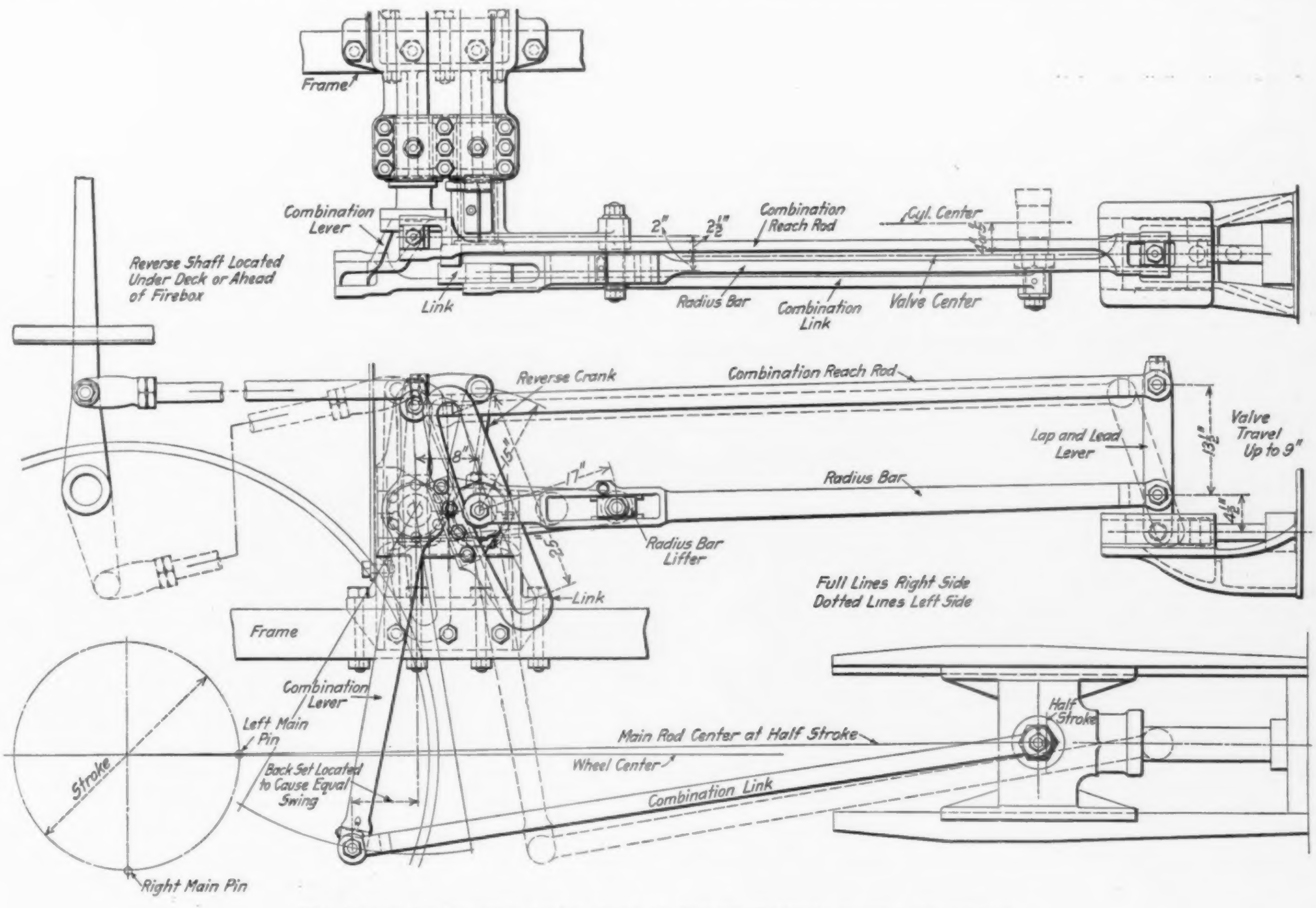
O. W. Young of Schenectady, N. Y., has designed a valve gear for locomotives which has a number of improved features when compared with the Walschaert design. It is actuated entirely by connections to the crossheads and is arranged to give a movement to the valve which materially increases the amount of the port opening for both admission and exhaust, and allows a 14-in. diameter piston valve to handle as large a volume of steam as a 20-in. diameter valve would with the ordinary design of Walschaert gear. It also simplifies the construction, allows easy standardization, and materially reduces the weight of the whole gear.

As will be seen by reference to the illustration, the combination lever which gives the valve its lap and lead movement, the same as in the Walschaert gear, is located some distance back of the crosshead and is keyed to a shaft which extends across the frames. On the opposite end of this shaft the link is keyed and gives the travel to the valve on that side. It will thus be seen that the connections to the crosshead on the right side of the locomotive provide for the lap and lead movement of the valve on the same side and the movement of the link which gives the travel to the valve on the opposite side. The same arrangement applies for the other side. Reversing is effected through a bell crank on either side that moves the radius rod by means of a block in a slotted opening. There are two reach rods, one for each side of the locomotive, and the arrangement is such that when one radius bar is lowered the other is raised. This balances the two gears for reversing, without the use of a counterbalance spring. The radius rod and the connection from the top of the combination lever both join a short link, the end of which is connected directly to the valve stem crosshead.

The link, combination lever and reverse bell crank have a common fulcrum on either side and the bearings for both of the shafts extending across the locomotive are contained in the same casting which is supported by a frame cross-tie.

A number of ellipses have been made with this gear on the valve gear model at the Schenectady plant of the American Locomotive Company. The model was arranged for a valve travel of 8½ in., which was secured with a 42 deg. angle of the link and an 18 in. link block lift. For a 9 in. travel the link angle would be 47 deg. In the case of a Walschaert gear, the link angle is 50 deg. for a 7 in. valve travel with the same amount of block lift and an eccentric circle of 22 in. One setting was arranged to give no lead or pre-admission and the release and closure were very late. At a 25 per cent cutoff the port opening was 15/64 in. This is equal to the opening the Walschaert gear gives with a 3/16 in. lead. If the Walschaert gear is set with no lead, the port opening at a 25 per cent cutoff is only 3/32 in.

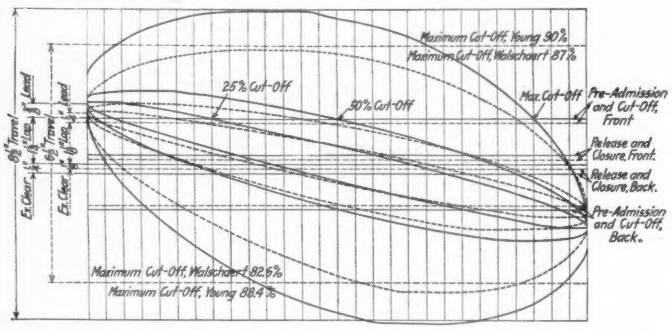
In one of the illustrations are shown the ellipses obtained from a Walschaert gear with a 6½ in. valve travel, 1⅛ in. lap and ¼ in. lead, having a sliding block radius bar lifter. On



The Young Locomotive Valve Gear Is Driven Entirely by the Crossheads

this is superimposed a similar ellipse from a Young gear with 8½ in. travel, 1¼ in. lap and ⅜ in. lead. It will be seen that the ellipse of the Walschaert gear is egg shaped, is fullest at the crank end and is considerable out of square in travel. This objection to the valve movement has been overcome by the Young gear and, in addition, the steam openings are 50 per cent wider at all cutoffs. The exhaust openings are also distinctly wider and the release in the higher cutoffs is more free. Closure is slightly earlier and the maximum cutoff is later.

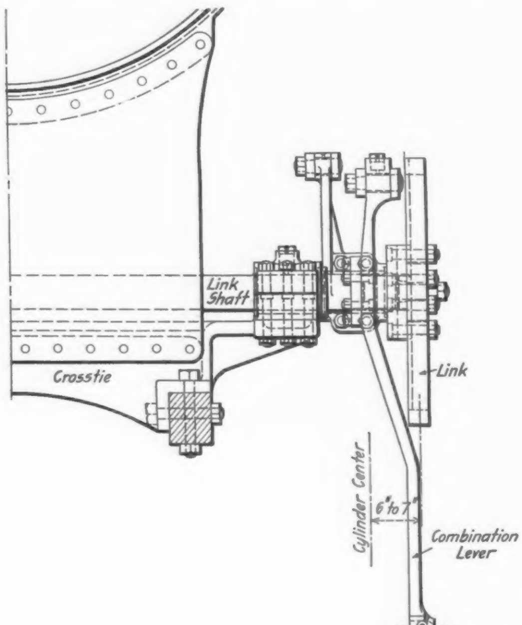
An inspection of these ellipses would indicate that the loco-



Comparative Ellipses of the Young and Walschaert Valve Gears

motive equipped with Young gear would be stronger in starting and would give considerably more power at high speed with a short cutoff. The indicator card based on this ellipse would be larger in size, showing a higher mean effective pressure, and in consequence the capacity for hauling trains would be increased.

It is from the information gained by a study of these ellipses that the statement is made that the Young gear is capable of handling as great a volume of steam with a 14 in. diameter



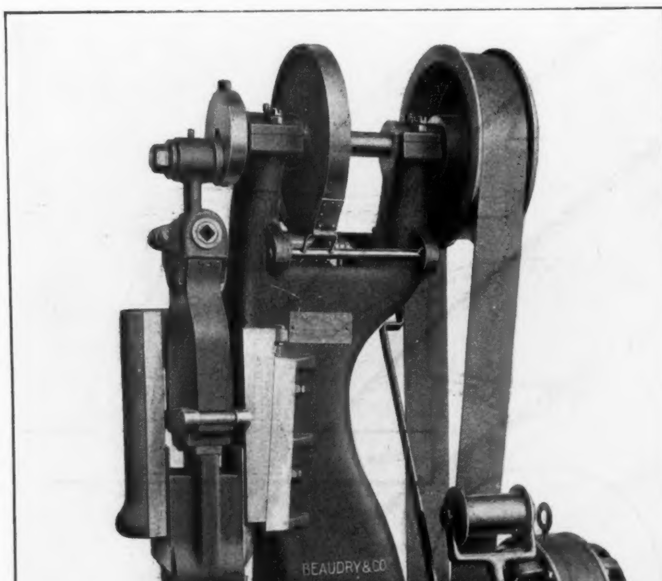
End Elevation of the Gear Showing the Location of the Link

piston valve as would a Walschaert gear with a 20 in. diameter valve. As a matter of fact, however, the 16 in. diameter piston valve is the largest size that has been used on a locomotive. This, of course, has great weight and friction, and is largely responsible for the introduction of screw and power reverse gears which are now quite generally used on the larger size locomotives. Eleven inch diameter piston valves with 28 in. port lengths are used with 20 in. diameter cylinders. These cylinders have 314 sq. in. of piston area. A 29 in. cylinder has 660 sq. in. piston area, and it has been customary to use the 16 in. diameter valve with 39 in. port lengths with this size. The port width with the Walschaert valve gear is no greater at 25 per cent cutoff in the large than it is in the small cylinders, and the increased volume for admission of steam is obtained entirely by the increase in the length of the ports. It will be seen that between the 20 in. and 29 in. cylinder, the cylinder volume has been more than doubled, but the port area has been increased only about 40 per cent. A 29 in. cylinder would require a 22 in. valve to give a port area at 25 per cent cutoff of equal ratio to the cylinder volume that an 11 in. valve bears to a 20 in. cylinder.

It would appear from this that the large engines have outgrown the capacity of the Walschaert gear and that they are not developing the hauling capacity at high speeds that they would be capable of with a freer inlet and outlet of steam. It is for this purpose, largely, that the Young gear has been designed, and it is anticipated that it will be found of especial value on very large locomotives.

MOTOR DRIVE FOR BEAUDRY HAMMERS

An improvement recently added to the line of Peerless hammers manufactured by Beaudry & Company, Inc., 141 Milk street, Boston, Mass., is the provision for a motor drive. A description of these hammers was published in the American Engineer of



Beaudry Hammer Equipped with Motor Drive

October, 1912, page 541. The addition of the motor drive makes but few changes necessary in the construction of the hammer, the principal ones being the addition of a supporting frame for

the motor and the placing of the driving pulley outside the bearings on an extension of the shaft. These are both clearly shown in the illustration.

CROSS-SLIDE FLAT TURRET LATHE

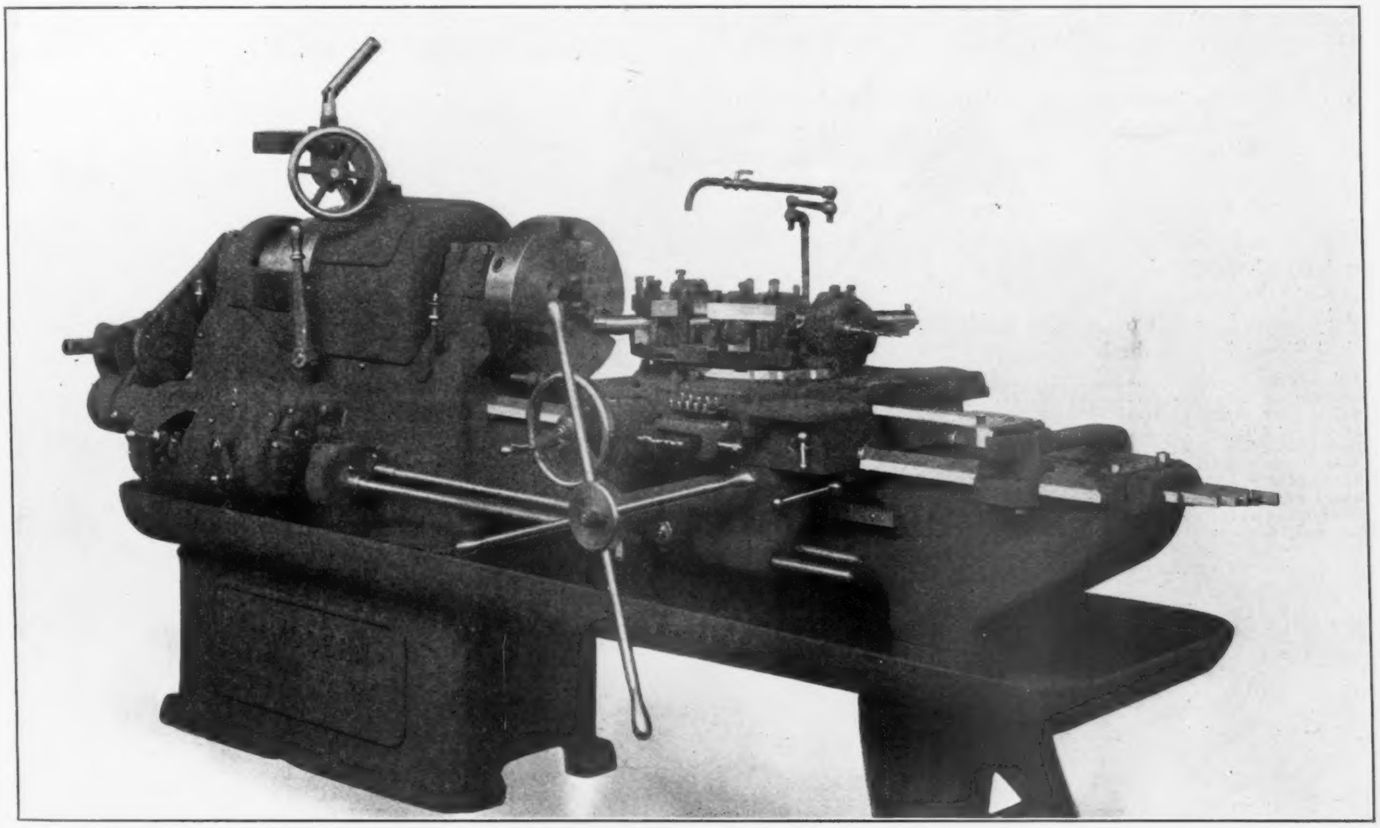
Among the more interesting of the recent machine tools is the cross-slide flat turret lathe designed by the Modern Machine Tool Company, Cincinnati, Ohio. This company has been building a flat rigid turret lathe for some time, which has been very popular and successful, and the new lathe differs from the rigid model only in those features of the carriage and turret directly connected with the cross slide.

Extra heavy cuts and the use of a gang of tools of large size are allowed on this machine because of the ample size and strength of all parts and the rigidity of the bed, as well as the method of supporting it. Vibration and chattering are noticeable by their absence even when high speed steel tools are used with heavy cuts. Success in this direction implies accuracy in the finishing of the various parts of the tool and extreme care in their assembling.

The head and bed are cast in one piece. The head is friction back geared and has twelve spindle speeds in exact geometric progression. The back gears are located within the head directly under the spindle. The friction gears, roller feed and all revolving parts are enclosed and all gears and moving parts throughout the whole machine are covered to prevent injury to the operator. The machine is built to comply with the laws passed in many states in connection with the protection of workmen. The bed rests on a three point bearing and is deep and heavy, being crescent shape in section and reinforced under the front spindle bearings.

The carriage is gibbed on the outer edge of the bed by flat gibs throughout its entire length and the bearing on the bed is in full contact from end to end with the entire depth of the V's. The carriage has a system of twelve stops so arranged that two may be used for each tool. A binder is provided for clamping the carriage to the bed during forming and cutting off operations. The backward movement of the carriage automatically turns the turret to each new position the instant the tool leaves the work and is so arranged that it may be turned to any one of the six positions without making any other stop. The adjustable dog for operating the index bar is clamped to the V and governs the position of the carriage at the time when the turret begins to revolve. The carriage is also provided with independent adjustable stops which operate automatically for each position and may be operated in any combination which may be desired when two or more are needed for any position of the turret.

The cross slide has 195 sq. in. bearing area on the carriage and has a long narrow dovetailed guide to prevent cramping. A full length taper gib takes up the wear and a parallel gib on the rear holds the cross slide in place. The center position is automatically and positively located by a taper locking bolt in the head end of the carriage which may be disengaged when the cross feed is used.



Modern Cross-Slide Flat Turret Lathe

The cross slide has ten stops which operate for either direction and it has 7 in. of travel. The stops may be used for one tool or in any combination for any series of tools. The graduations for the micrometer adjustment of the cross slides are on the periphery of the cross feed-screw hand wheel. This cross slide has independent feeds in both directions which may be engaged while the machine is in operation. The start, stop and reverse are controlled by a single lever entirely independent of the carriage feed. When the cross feed is operated by hand, the screw with two beveled gears are the only moving parts. This avoids the strain on the screw and other parts common to a heavy train of gears.

The turret is a circular plate 18 in. in diameter and the lock bolt is located close to the front edge. It is provided with T slots of ample proportions, permitting the use of substantial planer head-bolts for securing the turning tools. These can be

secured one back of another for turning several diameters at one time.

The automatic roller feed is immediately behind the front spindle bearing in the head and thus allows feeding of all of the bar or stock. There are but three moving parts or members in this feed. The automatic chuck is operated by a single movement of the lever at the front of the head. It has a strong grip, no overhang, no end motion and requires no changing of the jaws. One set of jaws is adjustable for the full capacity of the machine, namely from 5/16 in. to 2¼ in. The roller feed is operated by the same lever that opens and closes the chuck.

Eight positively geared feeds, ranging from .005 to .085 in. per revolution in either direction are provided by the feed gear box. Only the lever and crank handle shown at the front are needed for changing the speeds. The motion from the feed box is transferred through a disc friction and a knuckle joint to the carriage feed rod.

The machine is provided with a patented belt shifter which is operated by a hand wheel on top of the head within easy reach of the operator. Motion from the hand wheel is transmitted to the belt loop through an intermittent rack and pinion, and a similar device is suspended from the countershaft and operates in unison. The belt loops are so timed that a half turn of the hand wheel to the left shifts the belt from the larger step to the smaller on the head while the loop on the upper device holds the belt out of contact with the edge of the cone on the countershaft. The next half turn of the hand wheel moves the upper loop in line with the corresponding cone on the countershaft and completes the change.

With the cross slide lathe a 15 in. three jaw, geared, scroll chuck with four sets of jaws is regularly furnished. The principal dimensions of the lathe are as follows:

Swing over V's	20 in.
Swing over carriage	16 in.
Swing over turret	6 in.
Travel of carriage	26 in.
Travel of cross slide	7 in.
Hole in spindle	2⅜ in.
Range of speed	18—350 r. p. m.
Range of feed	.005—.085 in.
Floor space	4 ft. x 11 ft.
Net weight	6,150 lbs.

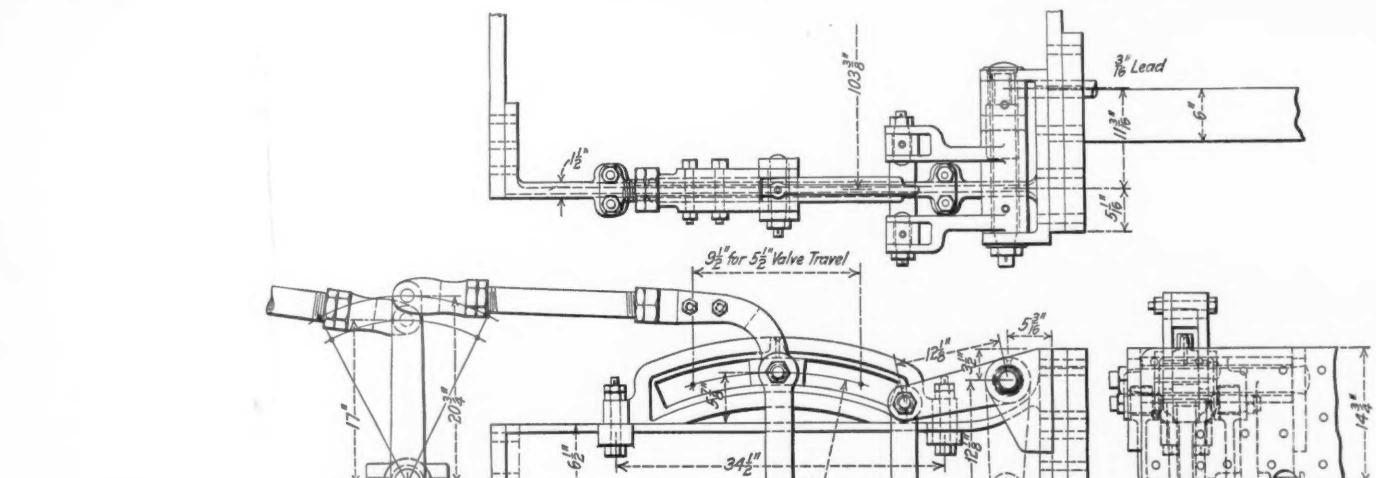
SOUTHERN LOCOMOTIVE VALVE GEAR*

A new valve gear that has for its principal features simplicity in construction, directness of action and ease of control, has been invented by William S. Brown, a locomotive engineer on the Southern Railway. It is of the radial gear type, but has no connection with the crosshead. It receives its motion from an offset crank in the same manner as the Walschaert gear. The floating end of the eccentric rod has two connections, one for the radius rod and the other for the link that is fastened to one arm of a bell crank lever. The other end of this lever is attached directly to the valve rod.

It is designed to give port openings which permit of using the steam for a longer portion of the stroke without loss of power due to back pressure and wire drawing, which is a feature much to be desired, and which will permit of an increase in the tonnage hauled and lower the rate of fuel consumption. In a recent test with the Westinghouse dynamometer car a consolidation engine equipped with this gear developed a draw bar horse power of 1,074, while an engine of the same class and size but equipped with an outside gear of a different, although standard type developed only 918 h. p.

The Southern valve gear can be applied to any class of locomotive having either inside or outside valve gears. It is so designed that all movements are made as directly as possible. Inasmuch as this gear is made up of but few parts there is a correspondingly small number of pins and bearings to maintain, which is a good point in its favor. For the same reason it will be possible to keep a smaller number of parts in stock for replacement. The link is rigidly held in a horizontal position which does away with the wear at this point, as the block only moves in the link when the cut-off is being adjusted by the reverse lever. This feature also eliminates the trouble of the block slipping in the link while the engine is running, and permits of the cut-off being easily adjusted while the engine is running at a high rate of

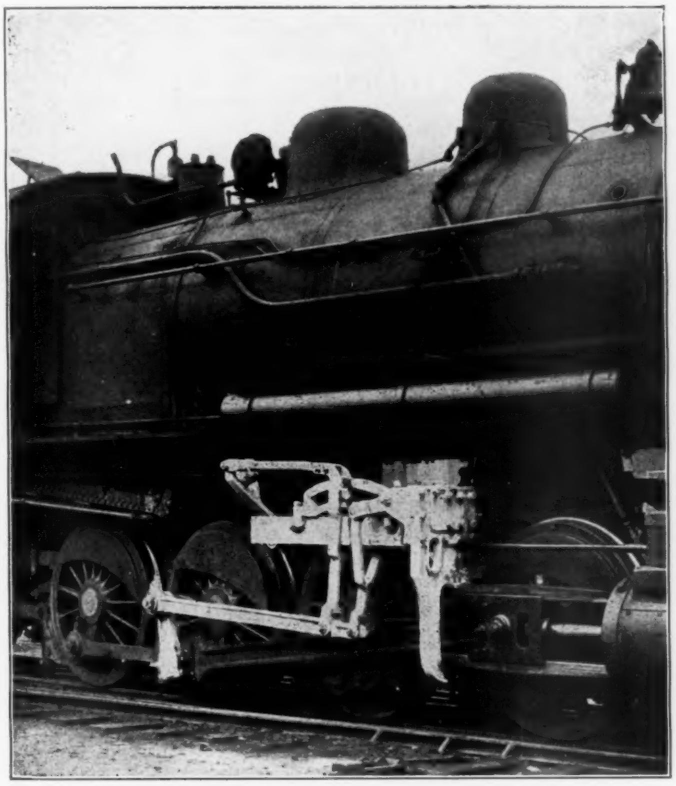
*From a paper presented at the November meeting of the Southern & Southwestern Railway Club by W. S. Brown, a locomotive engineer on the Southern Railway and the inventor of this valve gear.



Arrangement of the Southern Locomotive Valve Gear

speed. This latter feature will be appreciated by enginemen, and will induce them to work the engines at as short a cut-off as possible, with a resulting saving in fuel.

This gear weighs 2,000 lbs., and has been applied to both passenger and freight locomotives. It has been in service on a 22 in. x 30 in. consolidation freight engine for over 30,000 miles and has not shown any appreciable wear on the pins and bush-



Southern Valve Gear Applied to a Consolidation Type Locomotive

ings, nor has there been any expense for repairs. It is sold by the Southern Locomotive Steam Engine Valve Gear Company, Knoxville, Tenn.

RAILWAYS OF NEW ZEALAND.—Except for 29 miles of private lines, the railways of New Zealand are in the hands of the government, which now owns and operates 2,860 miles of 3 ft. 6 in. gage line.

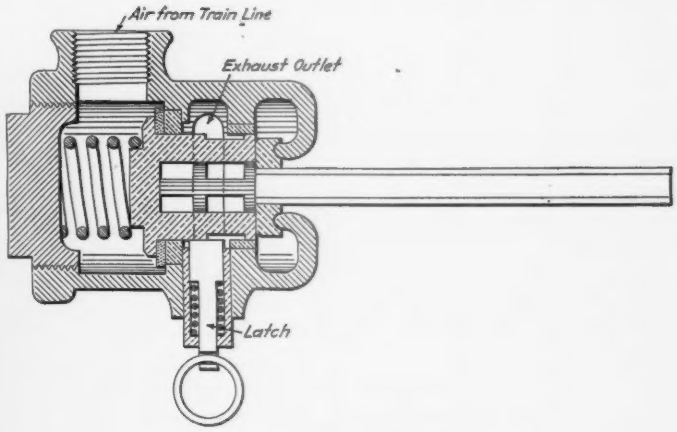
USE OF ALLOY STEELS.—Alloy steels are being more widely used for many locomotive parts. In most cases the heat-treated steel is employed and very excellent results are reported. In a few cases a considerable reduction of section and of weight has followed the use of this improved material. More generally, however, the greater strength has been used for the purpose of reducing the unit fiber stress and thus increasing the reliability of the parts. The alloy most generally employed has been a chrome vanadium. The number of parts of this material applied during the past year to locomotives is given in the following table:

	Number of Engines.	Number of Parts.
Axles	466	1,277
Crank pins	188	580
Piston rods	69	138
Main rods	347	734
Side rods	354	1,840
Springs (engine and tender)	306	...
Frames	776	1,592
Engine truck axles	62	62
Wheels	...	700
Tires	...	1,000

The frames are simply annealed, but all other parts are heat-treated.—*Railway Age Gazette.*

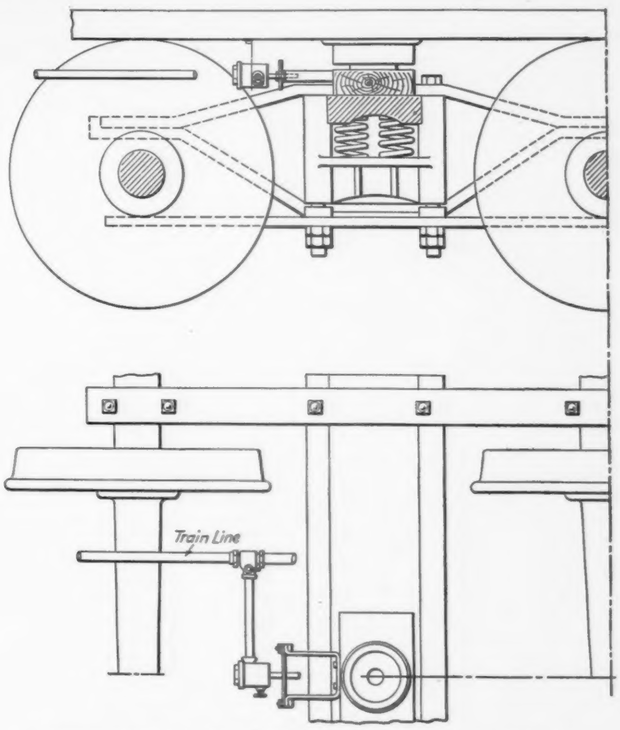
SAFETY AIR BRAKE APPLIANCE

A device which is designed to set the brakes on a train in case of the derailment of one or more pairs of wheels has been perfected by the Wright Safety Air Brake Company, Greensboro, N. C. It is automatic in its operation and consists of a spring seated release valve closing a passage from the chamber behind it which is connected directly to the train line; a protruding stem which operates the valve and a latch for holding the valve



Section Through Release Valve

when opened. The device is secured to the car body on the center line and in a position relative to the truck shown in one of the illustrations. The long protruding stem passes through a yoke supported by means of a pair of brackets from the truck transom or the bolster as may be desired. The aperture in this yoke is of the shape and size determined by experience and is such as to allow free movement under safe running con-



Arrangement of the Safety Release Valve on the Car

ditions without interference with the stem. An abnormal movement of the yoke, however, such as derailed wheels, serves to displace the stem and open the spring seated valve in the casing, which thus allows the air to escape from the train line and applies the brakes. When the valve has been opened a sufficient distance a latch comes in action and holds the valve in the

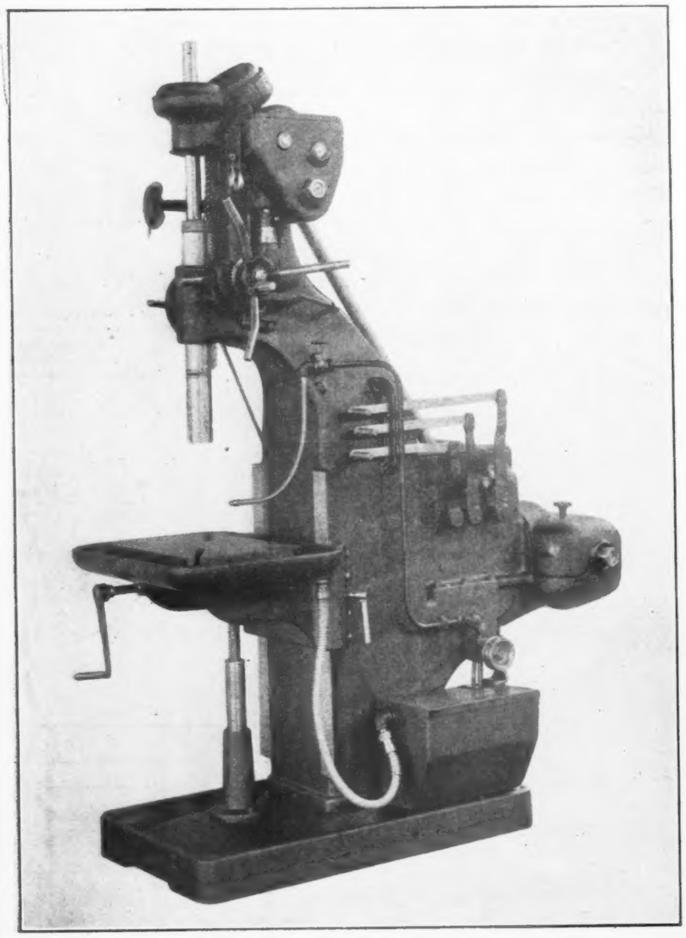
open position. This arrangement provides for the continual release of the air in case the stem or the operating yoke becomes broken through an excessive movement of the truck. By means of the ring shown at the bottom of the latch, the valve can be released and assumes the closed position, after the truck has been replaced and it is desired to again start the train.

This device has been in actual service on the Southern Railway for about three years. During this time it has been in the process of development and altogether there have been 29 different models used. It is believed, however, that it is now perfected and the Southern Railway is reported to be equipping a large number of cars with it.

GEARED DRILL

A self-oiled, 22 in., all-geared drill, of strong construction and intended for rapid production and heavy work has recently been brought out by the Barnes Drill Company, Rockford, Ill.

All bearings, aside from the spindle sleeve and cross spindles, are automatically and continuously lubricated, oil being supplied by a geared pump in the reservoir of the machine. Oil is also continuously distributed to all the gears. This self-oiling system is manufactured under license from Kearney & Trecker Company.



Self-Oiled 22-In. Geared Drill

All transmission gears but those of the friction clutch, are cut from special high grade steel and heat treated. There are eight changes of speed, all controlled by levers within reach of the operator from his position in front of the machine. The spindle may be stopped by placing the shifting lever on the neutral position or by throwing out the clutch gear. There are ten instant changes of the geared feeds, also controlled by levers directly in front of the operator and the feeds are indicated in plain figures on the index dial plate. All important feed gears are cut from steel and are case hardened. A safety collar protects the machine against damage from overload. Drills from ½ in. to 2 in. in diameter may be used.

In some recent tests on this machine the following results were obtained:

Size of "Celfor" Drill.	Speed, R. P. M.	Feed.	Material.	Inches Drilled per Minute.
2 in.	140	.041 in.	2 in. thick, cast iron	5¾
2 in.	232	.025 in.	2 in. thick, cast iron	5.8
2 in.	232	.041 in.	2 in. thick, cast iron	9.5
2 in.	367	.020 in.	2 in. thick, cast iron	7⅓
1½ in.	230	.041 in.	2 in. thick, cast iron	9.4
1½ in.	367	.041 in.	2 in. thick, cast iron	15
1¼ in.	456	.041 in.	2 in. thick, cast iron	18⅔
1¼ in.	575	.041 in.	2 in. thick, cast iron	23½
1 in.	360	.025 in.	Steel	9
1¼ in.	350	.020 in.	Steel	7

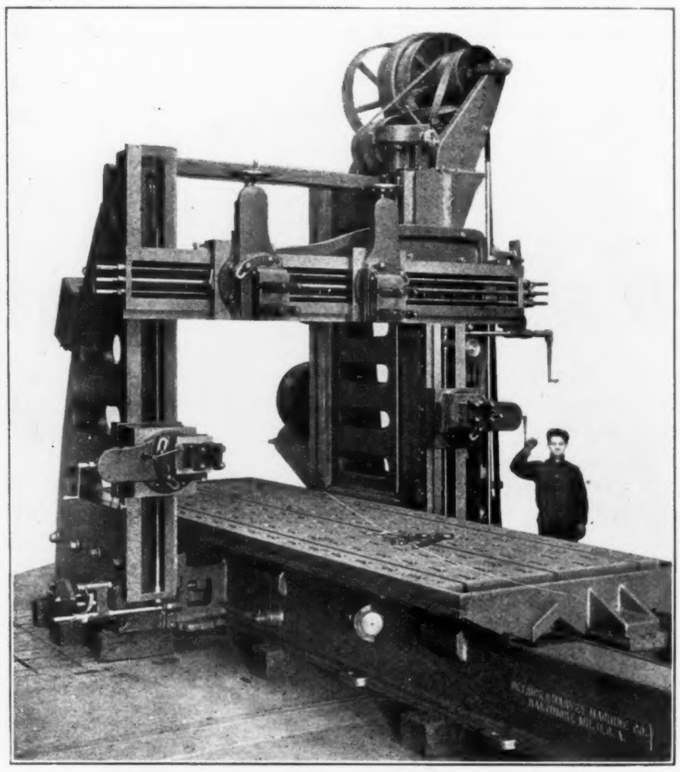
For motor drive, the frame is strengthened and provided with a table for supporting the motor.

The following are the principal dimensions and data:

Height of machine	85 in.
Distance, center of spindle to face of column	11 in.
Maximum distance from table to nose of spindle, No. 5 taper	32 in.
Maximum distance from table to nose of spindle, No. 4 taper	33¼ in.
Spindle travel	14 in.
Diameter of spindle sleeve	2¾ in.
Diameter of spindle, driving end	1¾ in.
Diameter of nose of spindle	2 11/16 in.
Morse taper	Either No. 4 or No. 5, as preferred
Width of steel rack in spindle sleeve, 8 pitch	1⅛ in.
Size of table, working surface	20 in. x 14 in.
Vertical travel of table	23 in.
Ten feed changes: .003, .005, .009, .013, .017, .020, .025, .041, .065, and .093	
Eight speed changes: Direct—575, 456, 367, 233; back gears in: 144, 114, 92, 58	
Speed of driving pulley	500 r. p. m.
Size of driving pulley	14 in. x 5 in.
Floor space, front to back	65 in.
Floor space, width	31 in.
Net weight, with regular table and oil pump attachment, without motor	2,620 lbs.

CONVERTIBLE OPEN SIDE PLANER

The large size, convertible, open side planer shown in the illustration has recently been installed in one of the large eastern railroad car shops. This machine has been designed and developed by the Detrick & Harvey Machine Company, Baltimore, Md., for the purpose of providing for a wide range of planer work, such as is frequently necessary in railroad shops.



Detrick and Harvey Convertible Planer

Primarily it is a double housing planer but, through the removal of the outer housing or post, the machine is converted to an open side planer. In its usual form it provides four tool heads, two being on the cross rail and one at either side. In fact the outer housing is not intended to stiffen the cross rail or to impart any rigidity to the machine, but it is provided entirely for the purpose of carrying the outer side tool head. It can be quickly removed, leaving the machine with three tool heads and in readiness to handle any work that would not pass between the housing.

What is usually termed a cross rail in the double housing type of planer is, in this case, replaced by an L shaped casting consisting of a horizontal arm and a downwardly extending leg, cast integral therewith. This leg takes a bearing on the main housing for a distance about 50 per cent. greater than the overhang of the cross beam. The cross beam is further stiffened at the rear by a triangular brace which extends to a bearing on the main housing. This construction gives it a rigidity and strength to accurately perform very heavy work.

The side head on the right hand or operating side of the machine is not mounted on the housing or post, but is placed on a slideway which is secured to the downwardly projecting leg of the cross beam. The support for the tool on this head is brought as close to the housing as possible. The slideway is adjustable and, if, in the course of time, the heads on the cross rail and the side head get out of square, the error can be readily and promptly corrected by reason of this adjustability.

Spiral pinion drive has been employed because of the combination of simplicity, efficiency and power, as well as the absence of numerous parts. In this drive the pinion is only one geared train removed from the belt or motor, while in the case of a spur gear drive the wheel is four trains removed. The spiral pinion drive contains but four bearings and three gears, thus greatly reducing the friction loss.

Friction feed is provided which consumes power only when the tool is cutting. This construction is positive in action but is frictional against overload.

REFRIGERATOR CAR DOOR FIXTURES

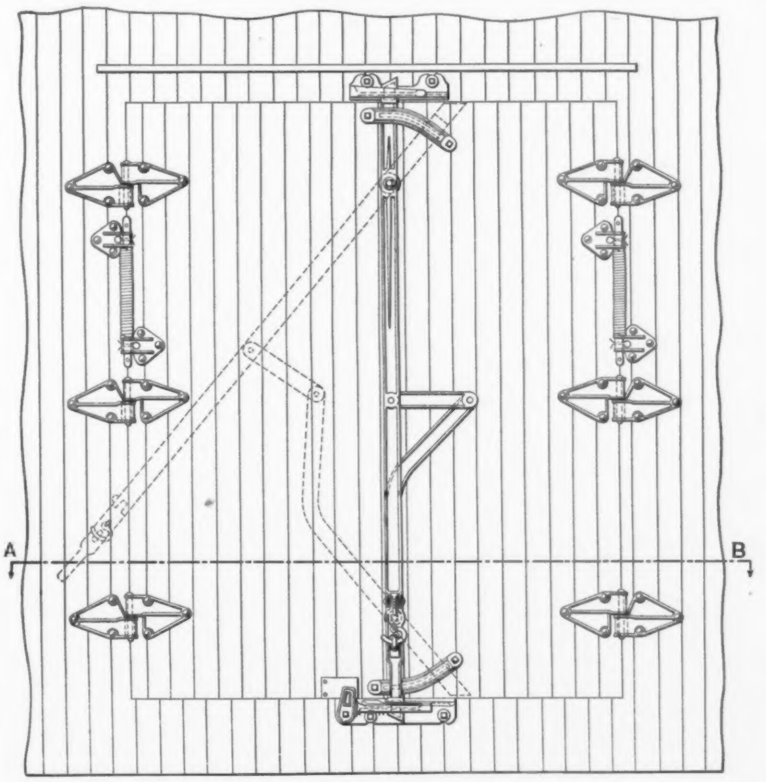
One of the principal causes of damage to shipments in refrigerator cars is due to the doors not fitting tight when closed, allowing the warm air to enter the car in summer and cold air in winter. With a view of improving this feature of the car, and also of reducing the cost of up-keep of the doors, the fixtures shown in the illustration have recently been devised.

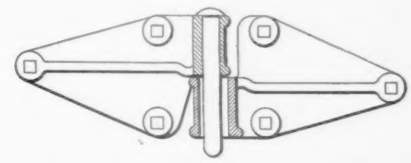
It often happens that the doors are not tightly closed on account of the fastener bar not engaging the keeper casting either at the top or bottom. To insure the doors always being completely closed, the Garland refrigerator car door closing and opening device was designed about two years ago, and was described in this journal (March, 1912, page 139).

Even when the doors are completely closed, there are many cases where the outside air can get into the car on account of irregular or defective packing around the door casings. The packing may be heavy or thick at one side of the door and light at the other side. For the purpose of equalizing the pressure on the door packing at the sides, top, bottom, and at the center where the doors meet, an adjustable hinge has been devised. This allows sufficient play or movement to permit the doors when being closed to seat themselves in the door opening with equal pressure on the sides and at the center. When cars are new, the doors often bind at the center, and it is necessary to trim them off in order to get them closed. After the cars have been in service for some time the doors dry out and do not fit closely at the center. It is the purpose of this hinge to have the doors fit tightly at all times without having to make alterations after the cars go in service.

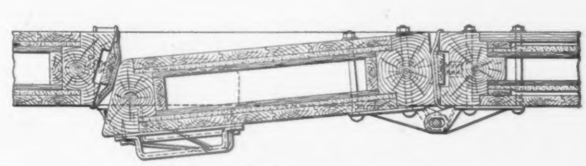
The hinges are made of malleable iron in two parts. The half that is applied to the post is made with a slotted or elongated pin hole. The hinge pin is cast in the other half that is applied to the door. When the hinges are applied and the two halves put together, the doors are allowed a lateral movement of one-half of an inch, and also an upward movement.

Another device in connection with the adjustable hinge is a

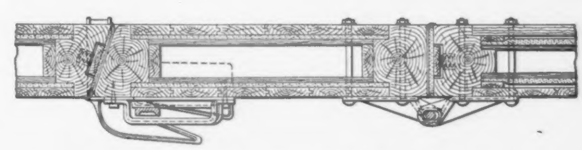




Longitudinal Section Through Adjustable Hinge.



Longitudinal Section A-B Door Closing.



Longitudinal Section A-B Door Closed.

Adjustable Hinge and a Spring Closing Fixture for Refrigerator Car Doors

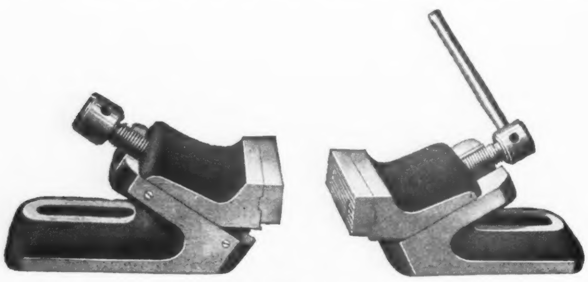
torsion spring, which is designed to operate in conjunction with the hinge. This spring is placed between the middle and upper hinge for the purpose of keeping the doors closed when they are not hooked back against the sides of the car. The desirability of having some means of keeping the doors of refrigerator cars from swinging while the cars are being switched is recognized by all who have the handling of such cars.

Many men have been killed or seriously injured by being hit by a swinging refrigerator door. There are many doors torn off every year on account of not being fastened in a closed position or hooked back against the sides of the car. The torsion spring shown is of sufficient strength to keep the doors in a closed position when not fastened or hooked back.

These devices have been designed by Thomas H. Garland, and are being handled by Mudge & Company, Railway Exchange, Chicago, Illinois.

DIVIDED MACHINE VISE

The vise shown in the illustration is suitable for use on the tables of planers, milling machines, drills, etc., and takes the place of the ordinary machine parallel vise. It is manufactured by Schuchardt & Schutte, 90 West street, New York, and is intended to overcome the difficulties caused by the limitation in the length of the base plate of the ordinary vise. It will hold work up to the full length of the table of the machine on which



Divided Vise for Clamping Work on Machine Tools

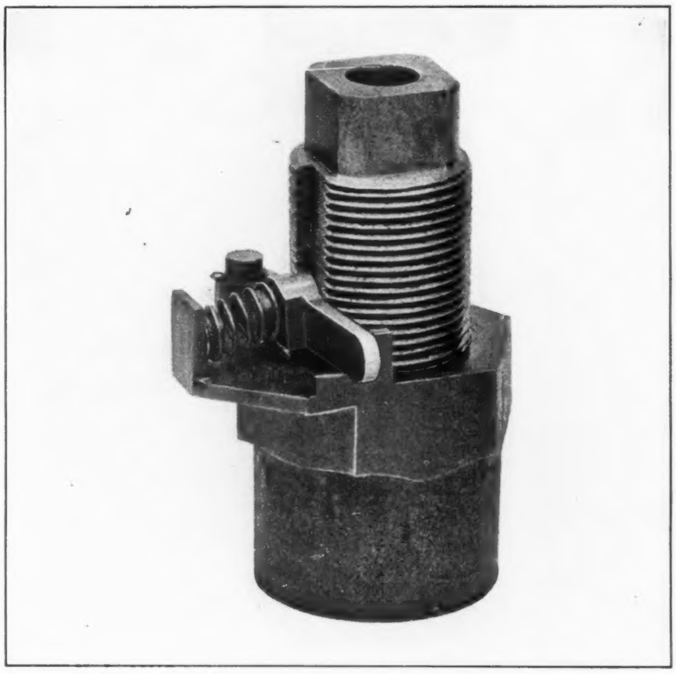
it is used and may be used for pieces with parallel, taper or irregular lines. The jaw is fitted to the body by a sliding V and an adjustable steel gib and screws provide the necessary adjustment for wear. The action of tightening the jaws forces the work down on the table or packing and saves the operator the use of a hammer. This vise may be used for either light or heavy work, and it is claimed that it costs considerably less than the ordinary vise.

LARGER LOCOMOTIVE CYLINDERS.—One of the changes in proportions which has been found advisable in order to obtain the full advantage of superheated steam, is the use of larger cylinders. At first this was accompanied by a reduction in the steam pressure and the increased size of the cylinders was simply to obtain the full power with the lower pressure. Lately, however, a tendency is noted toward using larger cylinders, even with the high pressures, and some of the more recent designs would, at first sight, seem to be considerably over-cylindered.—*Railway Age Gazette.*

THE GREATEST RAILWAY TUNNELS.—The world's greatest tunnels are to be found in Europe, and a brief summary of these in the *Engineer* shows that the greatest is the Simplon which is 12¼ miles in length. Two, the St. Gothard and Lotschberg, are over 9 1-3 miles in length. The Mont Cenis is a little over 7 miles in length. The Arlberg, in Austria, is 6¼ miles long. There are four tunnels between five and six miles in length, five between four and five miles in length, seven between three and four miles, and sixteen tunnels that are over two miles long. The longest tunnel in this country, the Hoosac, is four and one third miles long.—*Scientific American.*

LOCKED GREASE PLUG

Where the screw plug type of grease plug is used—and this form seems to be a favorite on a number of roads—difficulty has been found in obtaining a suitable form of locking device which will prevent the screw from backing out and not only removing the pressure from the top of the grease, but also dropping out and being lost. A form of plug which includes a locking device that will prevent this trouble is shown in the illustration. It consists of a brass body threaded on the bottom and screwed into the rod, and a wrought or cast iron hollow plug with a squared top and either a flat or hollow lower end. A suitable hinged or pivoted pawl is provided and is held in



Grease Plug Fitted with a Locking Device

place by a small coil spring. The iron plug is slotted on the side from the top of the threads to within ½ inch of the bottom of the plug, and the pawl is arranged with a lip which engages this slot when it is in the locked position. It will be seen that there is a small shoulder on the body back of the pawl. This is provided to allow the pawl to be held in an unlocked position when the plug is being removed. When locked there is no means by which the screw can back out, although it can be turned down without disengaging the pawl or giving any attention to this part.

This plug has been patented by O. N. Terry, 2404 West Division street, Chicago, Ill.

FREIGHT CARS IN SWEDEN.—The freight cars of Sweden are of a type similar to those generally used in England and on the continent. Swivel trucks for use on freight cars, however, are unknown in Sweden. Only the light, four-wheel cars which can be switched in yards by men without car movers, are in use in that country.

MARINES AS ENGINEMEN AND TRAINMEN.—Under instructions from the War Department, marines from the marine barracks, Camp Elliott, Isthmian Canal Zone, Panama, are riding on the regular passenger train locomotives of the Panama Railroad, armed with letters requesting engineers to give them all possible instructions relative to engine running, etc. This movement is being inaugurated for the purpose of having men in the marine service who can be promptly put in on railways in an enemy's territory to handle motive power and trains for the transportation of troops and provisions.—*Scientific American.*

NEWS DEPARTMENT

The Grand Trunk shops at Port Huron, Mich., were destroyed by fire on November 26.

The repair shops of Street's Western Stable Car Line in Chicago were partially destroyed by fire on December 4, with 25 cars.

It is announcd in Washington that beginning January 1 the postoffice department will abandon the practice of sending periodicals by freight trains.

L. B. Foley, superintendent of telegraph of the Delaware, Lackawanna & Western, is conducting experiments with the wireless telegraph between the company's stations at Scranton, Pa., and Binghamton, N. Y., and from these places to moving trains. A severe storm of sleet recently disabled the wires between Scranton and Binghamton, and for two hours the despatcher sent train orders between these two stations by the wireless telegraph.

Eastbound passenger train No. 16 of the Lake Shore & Michigan Southern was derailed on the morning of December 13, about 1 o'clock, at a point near Wickliffe, Ohio, by the malicious loosening of the rails. The fireman was killed and a mail clerk was injured. A. H. Smith, the newly elected president of the New York Central Lines, was in his business car at the rear of the train. The company offered a reward of $1,000 for the apprehension of the persons guilty of loosening the spikes and splice bars.

On the night of November 25 a special train consisting of a locomotive and two cars was run from Washington, D. C., to Jersey City, N. J., 226 miles, in four hours, the fastest trip ever made between the two cities. The route was over the Baltimore & Ohio, the Philadelphia & Reading and the Central of New Jersey. The train was run for a New York newspaper, to carry photographs taken at the marriage of the President's daughter. Enlargements of the pictures were made before leaving Washington, and some of the development work was done on the train. The train left Washington at 8:10 p. m., and arrived at Jersey City at 12:10 a. m. The best previous run between these cities, of which we find record, was 4 hours 11 minutes, over the Pennsylvania.

The American Institute of Consulting Engineers, of which Alfred Noble is president, has sent to President Wilson a letter requesting that an able and experienced engineer be appointed to one of the vacancies on the Interstate Commerce Commission. The letter points out the special fitness of an engineer to deal with questions coming before the commission concerning engineering and railroad operation. The railroad engineer's experience is useful also in dealing with the regulation of rates. The Institute has no candidate and declares that it has no motive except to serve the administration. The president is reminded that an engineer of the type under consideration would not serve in a subordinate capacity, under laymen, while yet he would probably make personal sacrifice for the honor of serving on the commission. The Institute asks not only the appointment of an engineer, but of an engineer with judicial temperament, executive ability, and the other obviously necessary qualifications for such a high office.

THE HARRIMAN SAFETY MEDAL

At the dinner of the American Museum of Safety in New York City on Friday evening of last week, the E. H. Harriman medal, provided by Mrs. Harriman as a memorial to her late husband, was awarded to the Southern Pacific Company. Professor F. R. Hutton in the presentation speech stated that the Southern Pacific had had no train accident fatal to a passenger during the past five years. Julius Kruttschnitt, chairman of the board of directors of the company, spoke on behalf of the road, and received a replica of the medal, which is to be made of gold.

PRIVATE FREIGHT CARS

The Interstate Commerce Commission has completed its investigation into ownership of freight cars in the United States, and now for the first time definite figures have been gathered as to the number and character of freight equipment of American railways. According to the commission's figures there are in the United States 2,300,000 freight cars owned by the railroads and 140,000 cars owned by car companies or other private ownerships. Private parties own more refrigerator cars than the railroads, the private car lines owning 54,000 and the railroads 49,000. The investigation developed that there are 43,000 freight cars in the United States built specially for the transportation of automobiles. Early in January the commission will hold a hearing in Chicago in connection with its investigation of alleged abuses in connection with private cars.

NEW YORK CENTRAL CAR DEPARTMENT STATISTICS

The year 1913 has been the busiest in the history of the car department of the New York Central & Hudson River and in a statement which has been issued to the officers and employees of the department thanking them for their hearty co-operation, F. W. Brazier, superintendent of rolling stock gives the following figures:

FREIGHT CARS REPAIRED.

	Light.	Medium.	Heavy.	Total.
*New York Central cars	906,158	12,624	17,430	936,212
*Foreign cars	1,697,270	14,553	5,969	1,717,792
Total	2,603,428	27,177	23,399	2,654,004
*Contract shop	153	1	2,894	3,048
Grand total	2,603,581	27,178	26,293	2,657,052

*Number of passenger cars repaired	76,886
Passenger cars owned, including electric cars	2,181
Number of freight cars owned	76,850
Number of repair yards	62
Number of repair shops	16
Number of men	7,225
*Amount of pay roll	$5,000,000.00
*Total labor and material, approximately	$14,000,000.00

*Months of November and December estimated.

AN APPEAL TO PARENTS

This is the title of a "safety-first" pamphlet which has been issued by the Ohio River & Columbus, and it is being circulated among school teachers with a view to having it put into the hands of children, with the hope that they will spread the gospel to their parents. Charles J. Finger, general manager of the road, in a letter to teachers, asking their assistance, reminds them that they already do for their pupils more than the strict letter of duty requires; and on the strength of this he asks them to assume one more burden which perhaps may be unappreciated. The closing chapter of the pamphlet (the whole pamphlet fills only three pages) is in part as follows:

Mothers, Fathers, Have You Ever Warned Your Children? Have you ever forbidden them to be in the neighborhood of the trains and station? Have you ever impressed upon them

the danger that always lurks near a railroad? If not, will you please do so? Sensible people cannot afford to neglect this as a duty, a duty as great as that of warning them against the misuse of fire arms or any other common danger. Forbid them to be around the tracks or station or yards, except business calls them there. Forbid them under any condition to walk the track or play on railroad bridges. Crossing signs, bells, signals, warnings mean very little to a child. Children do not realize that anything can happen to them. . . .

PAYING FOR IDEAS

The Delaware, Lackawanna & Western has announced to its officers and employees that any suggestion, recommendation or information tending to improve the safety, efficiency or economy of the company's operations, in any direction whatever, when proffered by an officer or an employee, will be submitted to a committee for criticism; and that any device, practice or measure which such committee may approve as useful for the company will be made the subject of an award of money to the one proposing it, the award to bear a fair relation to the money value which the adoption of the improvement shall prove to be to the company. Where an employee offers a device which he desires to have patented, the company will, if the thing be patentable, secure letters patent at its own expense, for the benefit of the inventor, the inventor agreeing that the company may use the invention on its lines free of royalty. President Truesdale, in a circular congratulating officers and employees on the successful and profitable outcome of the past year's activities, gives detail instructions for the proper procedure. Everything offered must be submitted to the Registrar of Contracts, 90 West street, New York City, and from there every proposition will be sent to the committee without the name of the proposer, this to provide for absolute impartiality. The president will designate the officer or committee to investigate the merits of proposals. The sole purpose of this action by the company is to arouse and utilize the interest of every one of the employees in perfecting the Lackawanna into the most highly efficient transportation machine that it can possibly be made.

GRASHOF MEDAL PRESENTED TO GEORGE WESTINGHOUSE

The ceremony of presenting the Grashof medal to George Westinghouse took place at the annual convention of the American Society of Mechanical Engineers on Wednesday evening, December 3. Unfortunately Mr. Westinghouse was unable to be present, and Dr. Goss, the president of the society, turned the medal over to Mr. Hartness, the president-elect, to be delivered to Mr. Westinghouse. The Verein Deutscher Ingenieure was represented by Geheimrath Romberg, G. D. Waetzoldt, Rudolph Herring, Henry Hess and Col. E. D. Meiers.

Mr. Westinghouse is the first American to receive this medal. It was founded by the Verein Deutscher Ingenieure of Germany in memory of Franz Grashof and is given by the Union only on recommendation of the council, and by unanimous vote in open general meeting, to men who have rendered pre-eminent service in the field of engineering, either in research or in practical activity. It is the highest honor in the gift of the engineering profession of Germany. The actual award of the medal to Mr. Westinghouse was made at the fifty-fourth annual meeting of the Verein Deutscher Ingenieure in Leipzig, Germany, June 23, 1913, officers and members of the American Society of Mechanical Engineers being present. In making the presentation Dr. Oskar von Miller, president of the Union, said:

"The distinction conferred by the largest scientific and technical society in the world is not a thing that is given away on a festive occasion, nor one to serve as a mark of attention and courtesy; it can be won only by actual services for the good of humanity. Engineers will have no doubt that George Westinghouse, whose name is so well known throughout the world, does deserve this distinction."

MEETINGS AND CONVENTIONS

International Railway General Foremen's Association.—At a meeting of the Executive Committee, held in Chicago, December 9, 1913, it was decided to hold the 1914 convention July 14-17 at the Hotel Sherman, Chicago. A campaign has been started to build up the membership and strengthen the association. The following papers have been selected for the 1914 convention program: Engine House Efficiency, by W. Smith, Chicago & North Western; Cylinders, Pistons, Crossheads, Guides and Valves, by J. T. Mullin, Lake Erie & Western; The Practice and Methods of Maintenance and Repairs to the Air Brake and Its Appurtenances, by C. M. Newman, Atlantic Coast Line; Autogenous Welding, by C. L. Dickert, Central of Georgia; Subsidiary Paper No. 1, The Taylor System, by W. W. Scott, Delaware, Lackawanna & Western; Subsidiary Paper No. 2, Railroading at a High Altitude, by J. W. Scott, Southern Railways of Peru.

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting of mechanical associations.

AIR BRAKE ASSOCIATION.—F. M. Nellis, 53 State St., Boston, Mass.

AMERICAN RAILWAY MASTER MECHANICS' ASSOC.—J. W. Taylor, Karpen building, Chicago. Convention, June 15-17, 1914, Atlantic City, N. J.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—A. R. Davis, Central of Georgia, Macon, Ga.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 North Fiftieth Court, Chicago; 2d Monday in month, Chicago.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—S. Skidmore, 946 Richmond street, Cincinnati, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—C. G. Hall, 922 McCormick building, Chicago. Convention, May 18-22, 1914, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 829 W. Broadway, Winona, Minn. Convention, July 14-17, 1914, Hotel Sherman, Chicago.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, Lima, Ohio. Convention, August 18-20, 1914, Milwaukee, Wis.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York. Convention, May 25-28, 1914, Philadelphia, Pa.

MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Karpen building, Chicago. Convention, June 10-12, 1914, Atlantic City, N. J.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOC. OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. & H. R., East Buffalo, N. Y.

RAILROAD CLUB MEETINGS

Club.	Next Meeting.	Title of Paper.	Author.	Secretary.	Address.
Canadian	Jan. 13	Cast Iron Wheel Records	H. H. Vaughan	Jas. Powell	Room 13, Windsor Hotel, Montreal.
Central	Jan. 9	Electro-Pneumatic Brake	Walter V. Turner	H. D. Vought	95 Liberty St., New York.
New England	Jan. 13	Training of Railroad Men	G. M. Basford	Wm. E. Cade	683 Atlantic Ave., Boston, Mass.
New York	Jan. 16	Rigid vs. Flexible Locomotive Boilers	W. J. Harkom	H. D. Vought	95 Liberty St., New York.
Pittsburgh	Jan. 23	Thermit and Its Qualifications	W. R. Hulbert	J. B. Anderson	207 Penna. Station, Pittsburgh, Pa.
Richmond	......	......	......	F. O. Robinson	C. & O. Ry., Richmond, Va.
St. Louis	Jan. 9	The Panama Canal	W. B. Doodridge	B. W. Frauenthal.	Union Station, St. Louis, Mo.

PERSONALS

It is our desire to make these columns cover as completely as possible all the changes that take place in the mechanical departments of the railways of this country, and we shall greatly appreciate any assistance that our readers may give us in helping to bring this about.

GENERAL

R. COLLETT, superintendent fuel service of the St. Louis & San Francisco, has had his title changed to superintendent locomotive performance.

P. O. WOOD has been appointed assistant superintendent locomotive performance of the St. Louis & San Francisco, with headquarters at Springfield, Mo.

W. F. DRYSDALE., mechanical engineer of the Northern Railway of Costa Rica at Limon, Costa Rica, has resigned to engage in other business.

J. V. B. DUER, foreman of motormen of the Manhattan division of the Pennsylvania Railroad at New York, has been appointed assistant engineer, with headquarters at Altoona, Pa., succeeding B. F. Wood, resigned.

J. M. HENRY, master mechanic of the West Philadelphia shops, of the Pennsylvania Railroad, has been appointed superintendent of motive power at Pittsburgh, succeeding J. M. James, resigned.

J. W. SASSER, master mechanic of the Seaboard Air Line at Jacksonville, Fla., has been appointed superintendent of motive power of the Norfolk Southern, with headquarters at Norfolk, Va.

G. CLINTON GARDNER, JR., general foreman of motive power on the Manhattan division of the Pennsylvania Railroad at New York, has been appointed assistant engineer of motive power on the Northern division, with headquarters at Buffalo. He began railway work on February 2, 1893, on the Middle division of the Norfolk & Western as inspector at the Roanoke, (Va.) machine shop. In May, 1894, he went to the Philadelphia & Erie division of the Pennsylvania Railroad as an apprentice at the Renovo, (Pa.) machine shop and subsequently was an apprentice at the Altoona shops. After completing his apprenticeship he was made material inspector and later was assigned to special work. On March 25, 1899, he was promoted to motive power inspector at the West Philadelphia shops, and about two years later was transferred to Jersey City, N. J., as motive power inspector in the office of the superintendent of motive power. In December, 1902, he was made assistant road foreman of engines on the New York division, with headquarters at Jersey City, and in April, 1905, was made assistant master mechanic at Trenton, becoming general foreman on the Belvidere division, now a part of the Trenton division, in December, 1906. In February, 1909, he was made general foreman of motive power on the Hudson division, and three years later became general foreman of motive power on the Manhattan division, in charge of enginemen, firemen, and shops, with headquarters at New York City, which position he held at the time of his recent appointment as assistant engineer of motive power on the Northern division of the same road, as above noted.

G. C. Gardner, Jr.

WILLIAM GARSTANG, general master car builder of the Cleveland, Cincinnati, Chicago & St. Louis and the Peoria & Eastern, retired from railroad service at the end of the past year, after an active career of 50 years in the mechanical department. Until February, 1913, Mr. Garstang was superintendent of motive power of the Cleveland, Cincinnati, Chicago & St. Louis, the Peoria & Eastern, and the Cincinnati Northern, and had held the title of superintendent of motive power for 25 years, 20 years with the Big Four and for 5 years, from 1888 to 1893, with the Chesapeake & Ohio. In February, 1913, he was relieved of a portion of his duties, and has since served mainly in an advisory capacity with the title of general master car builder. His former duties will continue to be performed by S. K. Dickerson, superintendent of motive power, and I. S. Downing, master car builder. Mr. Garstang was born February 28, 1851, in England, and was educated in the public schools. In 1862 he carried water for the contractors on the laying of track from Fort Erie to Niagara on the Canadian shore of the Niagara river, and in December, 1863, entered railway service as a machinist apprentice on the Cleveland & Erie, now part of the Lake Shore & Michigan Southern, at Cleveland, Ohio, where he remained six years. During this period he went to night school and studied mathematics and mechanical drawing. He was then for 11 years machinist and general foreman of the Atlantic & Great Western and the New York, Pennsylvania & Ohio; for three years general foreman of the Cleveland & Pittsburgh division of the Pennsylvania; for five years master mechanic of the Cleveland, Columbus, Cincinnati & Indianapolis, now the Cleveland, Cincinnati, Chicago & St. Louis, and in 1888 he was appointed superintendent of motive power of the Chesapeake & Ohio. On April 1, 1893, he was appointed superintendent of motive power of the Cleveland, Cincinnati, Chicago & St. Louis, which position he held until February 10, 1913. He has thus been connected for approximately 30 years with Vanderbilt roads, and during that time he has been closely identified with the wonderful progress that has been made in railroading. During his first service on the Cleveland & Erie the link and pin coupler was used on passenger cars as well as freight cars; passenger cars were heated by wood stoves and lighted by sperm candles, and portable platforms were used between cars during stops to keep people from falling through; the locomotives burned wood, weighed only about 70,000 lb., and were equipped with valve gears having the hook motion and the independent cut off, and wooden brake beams, brake heads and brake shoes were used, over the route that is now traversed by the Twentieth Century Limited. Mr. Garstang has been connected with the Master Car Builders' Association and Master Mechanics' Association for about 35 years, and was president of the Master Mechanics' Association in 1894 and 1895. He has served on the committees that adopted the M. C.

William Garstang

B. standard car axle, journal box, journal brass, journal wedge, and the standard wheel, and for the past 12 years has been chairman of the committee on standard wheels., When this committee first took up the wheel question there were 45 different designs in use, which have now been reduced to designs for 60,000, 80,000 and 100,000 lb. capacity cars. One of his most important recent achievements was the erection of the Big Four shops at Beech Grove, Ind., which he designed and contracted for, and the work was carried on under his supervision, in addition to his other duties.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

Charles Bowersox, general foreman of the Toledo & Ohio Central at Bucyrus, Ohio, has been appointed master mechanic at that point.

C. C. Elmes has been appointed road foreman of engines of the Philadelphia & Reading, with headquarters at Tamaqua, Pa.

Frank W. Mayo, engine house foreman at the Sunnyside Yards, Manhattan division of the Pennsylvania Railroad at Long Island City, has been appointed acting road foreman of engines of the Manhattan division, in charge of electric and steam service, and will continue in charge of the engine house at Sunnyside Yards, with headquarters at New York. The positions of foreman of motormen and general foreman of motive power have been abolished.

L. Showell has been appointed division foreman of the Atchison, Topeka & Santa Fe at Deming, N. M., succeeding G. J. Kintz.

Philip Stohlberger has been appointed road foreman of engines of the Atlantic City Railroad, with headquarters at Atlantic City, N. J.

CAR DEPARTMENT

C. M. Burcher has been appointed car foreman of the Atchison, Topeka & Santa Fe at Amarillo, Tex., succeeding E. A. Bronson.

R. V. Carleton has been appointed general foreman of the passenger car shops of the Canadian Pacific at West Toronto, Ont.

F. J. Harper has been appointed traveling piece work supervisor of the St. Louis & San Francisco, with headquarters at Springfield, Mo.

Dahl Holcomb has been appointed foreman of steel car repairers of the Atchison, Topeka & Santa Fe at San Bernardino, Cal.

George H. O'Brien has been appointed car foreman of the Atchison, Topeka & Santa Fe at Wellington, Kan., succeeding C. M. Burcher, transferred.

R. W. Pritchard has been appointed assistant superintendent, car department, of the Terminal division of the Rock Island Lines, with headquarters at Chicago.

F. Reeve has been appointed coach yard foreman of the Canadian Pacific at Vancouver, B. C., succeeding W. Woodhouse.

W. Woodhouse has been appointed car shop foreman of the Canadian Pacific at Vancouver, B. C., succeeding L. L. Hannah.

SHOP AND ENGINE HOUSE

H. Allen has been appointed locomotive foreman of the Canadian Pacific at Alyth, Alta., succeeding W. G. McPherson.

W. J. Andrews has been appointed locomotive foreman of the Canadian Pacific at Minnedosa, Man.

E. A. Barnwell has been appointed locomotive foreman at the West Calgary roundhouse of the Canadian Pacific, West Calgary, Alta., succeeding J. Reed.

Guy T. Foster has been appointed roundhouse foreman of the Atchison, Topeka & Santa Fe at Shawnee, Okla., succeeding P. S. Hoffar.

J. E. Giles has been appointed shop foreman of the Canadian Pacific at Lethbridge, Alta.

Edward P. Gray has been appointed general foreman of the Atchison, Topeka & Santa Fe at Arkansas City, Kan., succeeding B. A. Eldridge.

J. Honan has been appointed locomotive foreman of the Canadian Northern at Kindersley, Sask., succeeding W. Toll.

Chas. Johnson has been appointed division foreman of the Atchison, Topeka & Santa Fe at Williams, Ariz.

D. G. McDonald has been appointed locomotive foreman of the Canadian Pacific at Macleod, Alta., succeeding J. A. Maddick.

H. McHardy has been appointed locomotive foreman of the Canadian Pacific at Neudorf, Sask., succeeding W. J. Andrews.

W. G. McPherson has been appointed locomotive foreman of the Canadian Pacific at Moose Jaw, Sask.

C. D. Mack has been appointed general foreman of the Atchison, Topeka & Santa Fe at Winslow, Ariz., succeeding G. F. Tilton.

J. A. Maddick has been appointed locomotive foreman of the Canadian Pacific at Crowsnest, B. C.

J. Morton has been appointed locomotive foreman of the Canadian Pacific at Konora, Ont., succeeding J. H. Wilson.

Dennis Quinlan has been appointed assistant boiler shop foreman of the Atchison, Topeka & Santa Fe at Albuquerque, N. M., succeeding Roy Welch, promoted.

J. Reed, locomotive foreman of the Canadian Pacific at West Calgary, Alta., has returned to his former position as shop foreman at Alyth, Alta.

W. Toll has been appointed locomotive foreman of the Canadian Northern at Hanna, Alta.

Roy Welch has been appointed foreman of boiler repairs of the erecting shop of the Atchison, Topeka & Santa Fe at Albuquerque, N. M., succeeding Dahl Holcomb, resigned.

PURCHASING AND STOREKEEPING

J. R. Orndorff has been appointed assistant storekeeper of the Baltimore & Ohio at Mount Clare shops, Baltimore, Md.

W. H. Williams has been appointed storekeeper of the Baltimore & Ohio, with headquarters at Ivorydale, Cincinnati, Ohio, succeeding F. A. Murphy.

Speed of Early Locomotives.—A speed of 40 miles an hour with a light load, has been obtained upon the Manchester railway; and Mr. G. Stephenson, the engineer, has stated his opinion that an engine might be constructed to run 100 miles within the hour, although he acknowledges that "at that rapidity of motion the resistance of the atmosphere would be very considerable." Engines are now made with eight times the power of the Rocket, yet with little more weight resting on each rail, the load being equally divided upon six wheels, and the machinery placed in a more advantageous situation than formerly. The tubes of the boiler are made smaller and more numerous, and of brass instead of copper. The last engine put on the railway ran 23,000 miles with the most trivial repairs, taking every day four or five journeys of thirty miles each.—*From the American Railroad Journal, March* 15, 1834.

SUPPLY TRADE NOTES

The Railway Utility Company, Chicago, has abandoned its branch office in Vancouver, B. C.

W. H. Snedaker, local manager of the Griffin Wheel Company's plant at Tacoma, Wash., has been elected a vice-president of that company, with office at Tacoma.

Franklin L. Whitcomb has been elected president of the Griffin Wheel Company, with headquarters at Chicago, Ill., succeeding Thomas A. Griffin. Mr. Whitcomb was born at Worcester, Mass., on March 5, 1862. His first business experience was with a commercial wool house in Boston from 1882 to 1884. He then went to Cleveland, where he was in the boot and shoe business for two years. For two years, from 1886 to 1888, he was with the Atchison, Topeka & Santa Fe, in the purchasing department at Topeka and at Chicago, and since 1888 he has been with the Griffin Wheel Company. He was general sales agent of that company until 1909, and in that year he was elected to the vice-presidency, from which position he has just been promoted to that of president.

F. L. Whitcomb

W. W. Butler has incorporated and is president of the W. W. Butler Company, Ltd., of Montreal, Que. The new company will engage in the business of selling railway, marine and mining supplies; it is capitalized at $100,000 and will have offices in the Transportation building, Montreal. It will represent J. Stone & Company, Ltd., of London, who manufacture complete systems of electric train lighting, and the Canadian Gold Car Heating & Lighting Company, Ltd. It will also represent the American Steel Foundries in Canada, and will have the railroad selling agency for the Glidden Varnish Company. Mr. Butler will retain his interest in the Canadian Car & Foundry Company, the Canadian Steel Foundries, Ltd., and the Pratt & Letchworth Company, Ltd. He has in addition taken a controlling interest in the Dominion Lubricating Oil Company. With him is associated George T. Merwin, who formerly represented the Safety Car Heating & Lighting Company in Canada.

W. W. Butler

The Pittsburgh Steel Products Company, Pittsburgh, Pa., has opened an office at 1933 Railway Exchange building, St. Louis, Mo., in charge of A. F. McCoole, manager of sales, and C. F. Palmer, supervisor.

Frank A. Purdy, who for seven years has been manager of the Canadian Gold Car Heating & Lighting Company at Montreal, has been transferred to the New York office of the Gold Car Heating & Lighting Company. He will bear the title of sales manager for the Canadian company and also for the Gold Car Heating & Lighting Company in the United States, with headquarters in New York City. The W. W. Butler Company, Ltd., of Montreal, will act as selling agents for the Canadian Gold Car Heating & Lighting Company. Mr. Purdy was born in the central part of New York State in 1866. His family moved to Iowa in 1868. He began railroad work in 1887 as fireman on the Burlington, Cedar Rapids & Northern, now part of the Rock Island system, where he remained until 1892, when he went to Chicago to engage in the livestock commission business. In 1905 he joined the staff of the Gold Car Heating & Lighting Company. For about two years he did general field work on the selling force, subsequently being appointed to manage the Canadian company.

F. A. Purdy

Charles W. Allen, manager of the railway department of the Reading-Bayonne Steel Casting Company, Reading, Pa., has been made vice-president and a director of the Reading Specialty Company, a company recently organized to sell the cast steel products of the Reading-Bayonne Steel Casting Company. Mr. Allen received his education in the Tamaqua (Pa.) schools and served as a machinist's apprentice in the Tamaqua shops of the Philadelphia & Reading. He later became engine house foreman at Milton, where he remained for six years. In 1904 he was transferred to Reading as master mechanic of the Reading & Harrisburg division. He left this position on January 1, 1907, to become railroad representative of the L. S. Bordo Company, with which he remained until his appointment as manager of the railway department of the Reading-Bayonne Steel Casting Company. He is the son of G. S. Allen, one of the oldest members of the Master Mechanics' Association, who was formerly a master mechanic of the Philadelphia & Reading, and who served that road for 54 years.

C. W. Allen

The Canadian H. W. Johns-Manville Co., Limited, has moved its Toronto branch to No. 19 Front street, East. The new store and warehouse has a floor area of approximately

35,000 sq. ft. and is situated in the heart of the wholesale district.

Thomas A. Griffin has been elected chairman of the board of directors of the Griffin Wheel Company, Chicago. Mr. Griffin was born August 28, 1852, at Rochester, N. Y. His first business experience was as an apprentice at Rochester, and he has been in the car wheel manufacturing business continuously since 1868. He went to Detroit in 1875 and operated for the Michigan Car Company its plant known as the Detroit Car Wheel Company, manufacturing all the wheels made and used by the Michigan Car Company. In 1879 the Griffin Car Wheel Company of Detroit, was organized and a foundry built by T. F. Griffin, his father, associated with T. A. Griffin and P. H. Griffin. The following year Thomas A. Griffin went to Chicago, where he organized the Griffin & Wells Foundry Company, and in 1886 this company was merged into the Griffin Wheel & Foundry Company, Mr. Griffin at this time acquiring all of the interest in the Griffin Car Wheel Company at Detroit. Subsequently the name of the company was changed to Griffin Wheel Company. Besides having five foundries in Chicago the company operates foundries in Boston, St. Paul, Detroit, Kansas City, Denver and Tacoma, and a plant is being built at Los Angeles.

T. A. Griffin

Robert Christy Totten, president of the Nickel Chrome Car Wheel Company, Pittsburgh, Pa., died recently. Mr. Totten was born in Pittsburgh on January 6, 1833, and lived in that city his entire life with the exception of three or four years spent in St. Louis. His father was one of the earliest iron founders in the Pittsburgh region and organized the old Fort Pitt Foundry, which did a great deal of work for the United States government during the Mexican war in the casting of cannon. At the death of his father, which occurred in 1850, Mr. Totten, then only about 17 years of age, entered the foundry and continued in that business until about 1891. Since that time he had been engaged, to a greater or less degree, in the study of metallurgy, especially in connection with improvements in chilled iron castings. At the time of his death he was engaged in exploiting an invention relating to the use of nickel and chrome to chill iron for the manufacture of car wheels.

R. C. Totten

CATALOGS

Self-Opening Die.—A particularly interesting, fully illustrated discussion of the arrangement and operation of thread cutting dies is given in a catalog prepared by Wells Brothers Company, Greenfield, Mass. In addition to the discussion on the general principles of successful dies, the catalog contains illustrated descriptions of the type of self-opening die perfected by this company. This catalog includes information which will be of assistance to tool room foremen.

Car Wheel Lathe.—The new Putnam 42 in. coach and tender wheel lathe is well described in a leaflet being sent out by Manning, Maxwell & Moore, 119 West Fortieth street, New York. This lathe is a distinct advance in its field and provides for the turning of a pair of coach or tender truck wheel tires with only two operations and without the necessity of a single change of cutting tools. The new details used on the machine are separately illustrated and described in this leaflet.

Steel Axles.—A catalog from the Illinois Steel Company, Chicago, Illinois, contains the full text of the Master Car Builders' Association standard specifications for steel axles and also the standard specifications for car and tender axles prepared by the Illinois Steel Company. Illustrations are included showing the standard M. C. B. and A. S. & I. R. standard axle. A brief discussion of the proper method of manufacture as it is done at the Illinois Steel Company's mills forms the introduction.

Planing Machines.—A catalog devoted entirely to planing machines of various kinds has been prepared by the Betts Machine Company, Wilmington, Del. Planers in sizes from 36 in. to 150 in. by 144 in. are illustrated, and in each case the facing page contains a full but brief description of the construction. In addition to the complete machines, the catalog also contains illustrations and descriptions of some details. Reversing motor drive in connection with several sizes of these machines is also illustrated.

Furnaces.—"The cost of fuel is not as important as what you can get out of it, and this depends on how you utilize it, which in turn is governed by your furnace design and operation." The discussion in a catalog issued by the W. F. Rockwell Company, 50 Church street, New York, is largely based on this statement. It fully describes the construction and operation of various sizes and types of Rockwell furnaces and illustrates designs for a great variety of uses. Many of these are suitable for use in railroad shops.

Air Compressors.—The "Story of the Imperial" is the title of a booklet just issued by the Ingersoll-Rand Company, 11 Broadway, New York City. It outlines in a brief form the features of the design and construction of the Imperial line of air compressors. It is arranged to give the reader a thorough understanding of the various steps in the construction of the machine showing how the air compressors are designed and built. Each important operation in the manufacture is illustrated with excellent reproductions of photographs.

Pacific Type Locomotive.—Bulletin No 1,016 from the American Locomotive Company, 30 Church street, New York, briefly considers the field of train operation to which the Pacific type locomotive is especially adapted, and includes in its 19 pages, photographs of 42 designs that have recently been built by this company. A tabular comparison of an equal number of locomotives giving the full dimensions of each is also included. This is a very complete exhibition of the 4-6-2 type locomotives that have proven successful under many variations of traffic conditions in both passenger and freight service. The locomotives shown have weights on drivers ranging from 122,500 lbs. to 197,800 lbs.